

10 Geology, Soils and Groundwater

10.1 Introduction

- 10.1.1 This chapter presents the results of the geology, soils and groundwater assessment undertaken as part of the Design Manual for Roads and Bridges (DMRB) Stage 3 Environmental Impact Assessment (EIA) for Project 9 – Crubenmore to Kincaig of the A9 Dualling Programme, hereafter referred to as the Proposed Scheme, described in **Chapter 5**.
- 10.1.2 This includes assessment of potential impacts related to superficial and solid geology, designated geological sites, geodiversity features, mineral extraction, soils, potential contamination sources, groundwater and associated receptors, including Groundwater Dependent Terrestrial Ecosystems (GWDTE), groundwater abstractions and private water supplies (PWS).
- 10.1.3 The assessment is supported by the following appendices presented in **Volume 2** of this report:
- **Appendix 10.1:** Peat Survey Information
 - **Appendix 10.2:** Groundwater Dependent Terrestrial Ecosystems
 - **Appendix 10.3:** Groundwater Abstractions and Private Water Supplies
 - **Appendix 10.4:** Potential Contamination Sources
 - **Appendix 10.5:** Preliminary Peat Landslide Risk Assessment
 - **Appendix 10.6:** Outline Peat Management Plan
- 10.1.4 Supporting considerations related to the assessment have also been addressed separately within **Chapter 8**, **Chapter 11** and **Chapter 12**, and associated appendices in **Volume 2**, with regards to agricultural land use and viability, hydrology, fluvial geomorphology, drainage, flooding, ecology and environmental designations. National and local planning policies relevant to geology, soils and groundwater are described in **Chapter 19**, together with an assessment of the Proposed Scheme compliance against these.

10.2 Approach and Methods

Scope and Guidance

- 10.2.1 This EIA has been undertaken using the guidance in DMRB Volume 11 Section 3 Part 11 ‘*Geology and Soils*’ (The Highways Agency *et al.*, 1993), taking account of guidance on contaminated land in ‘*CLR11 – Model Procedures for the Management of Land Contamination*’ (Environment Agency, 2004) where appropriate, and DMRB Volume 11 Section 3 Part 10 HD 45/09 ‘*Road Drainage and the Water Environment*’ (The Highways Agency *et al.*, 2009).
- 10.2.2 Consideration of soil includes potential impacts in terms of conservation value and impacts on peaty soils and peat. The potential agricultural productivity of soil is also considered, though impacts in relation to agricultural land use and viability are assessed in **Chapter 8**. Made ground is included in the assessment of potential contamination sources, while earthworks volumes and ‘cut and fill balance’ of the Proposed Scheme is described in **Chapter 5**.

- 10.2.3 For groundwater, the assessment considers potential impacts on level and flow, quality, GWDTE and groundwater-related changes to surface water, groundwater abstractions and PWS. Impacts in relation to fluvial geomorphology, surface water quality, flooding and ecological receptors that are not groundwater dependent are assessed in **Chapter 11** and **Chapter 12** where relevant.

Study Area

- 10.2.4 The assessment covers a study area extending to 250m from the permanent and temporary works boundaries of the Proposed Scheme. For GWDTE, the study area extends to at least 100m from the temporary and permanent works boundaries, and up to 250m, where required.
- 10.2.5 Impacts on groundwater abstractions and PWS have been assessed to a distance of 850m from the temporary and permanent works boundaries of the Proposed Scheme. This was considered to correspond to the minimum study areas applied for groundwater abstractions under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR).

Baseline Data Collection

- 10.2.6 Baseline conditions described cover the following aspects:
- Superficial and solid geology
 - Designated geological receptors and features of geodiversity interest
 - Mineral extraction
 - Soils and peat
 - Groundwater and associated receptors, including GWDTE, groundwater abstractions and PWS
 - Potential contamination sources.
- 10.2.7 Baseline conditions were determined through desk-based data assessments, consultation with statutory and non-statutory bodies and landowners, ground investigations and field surveys.

Desk-based Assessment

- 10.2.8 The desk-based assessment included a review of the following information:
- Ordnance Survey (OS) historical maps (sourced from Envirocheck Reports) dating back to 1856 for information on former land use, potential contamination and information on PWS
 - British Geological Survey (BGS) data including BGS Geological Maps, BGS Hydrogeological and Groundwater Vulnerability Maps, BGS borehole logs and BGS publications
 - James Hutton Institute (JHI) published soil maps, thematic data and derived information, including the National Soil Map of Scotland (1981)
 - Scottish Environment Protection Agency (SEPA) interactive River Basin Management Plan mapping and the Scottish Wetland Inventory
 - Scottish Natural Heritage (SNH) designation database (SNH, 2016a) and Carbon and Peatland Map (SNH, 2016b)
 - Previous assessments and information, including the Strategic Environmental Assessment (SEA) and Addendum Reports for the A9 Dualling Programme (Transport Scotland, 2013 and

2014a), DMRB Stage 1 Preliminary Engineering Services Report (Transport Scotland, 2014b) and Geotechnical Preliminary Sources Study Report (PSSR) (CFJV, 2016).

Field Surveys

10.2.9 Site walkovers were conducted by the CH2M Fairhurst Joint Venture (CFJV) to obtain information on the baseline geology, soil and groundwater conditions and PWS locations. These were also supplemented by the following specific field surveys:

- Phase 1 Habitat Surveys (CH2M, June to September 2014)
- National Vegetation Classification (NVC) Surveys (MacArthur Green, June to July 2015)
- Preliminary peat probing surveys (CFJV, February to March 2017)
- Supplementary peat probing and sampling surveys (CFJV, June and November 2017).

Consultations

10.2.10 Consultations were undertaken with the following:

- Cairngorms National Park Authority (CNPA) and The Highland Council (THC) for information on potential contamination sources, PWS and any additional relevant information
- SEPA for information on groundwater abstractions and potential contaminated land uses
- SNH for information on the location, extent and boundaries of environmental sensitivities and geodiversity features in the vicinity of the Proposed Scheme
- HighWater (Scotland) Ltd and private landowners/ residents via questionnaire, for additional information on groundwater abstractions or PWS, their source, location, type and use.

Ground Investigations

10.2.11 Intrusive ground investigations (GI) were conducted by Raeburn Drilling and Geotechnical Ltd (Raeburn) between August and December 2015 (referred to as the 'Advanced GI') and by BAM Ritchies between November 2017 and January 2018 (referred to as the 'Preliminary GI'). Both phases consisted of boreholes, trial pit excavations and peat probes, in addition to groundwater and ground gas monitoring, and chemical testing of soil, groundwater and surface water samples.

10.2.12 The results of the Advanced GI and Preliminary GI are presented in the '*A9 Dualling – Glen Garry to Dalraddy, Project 9 Crubenmore to Kincaig Draft Report on Ground Investigation*' (Raeburn, March 2017) and '*A9 Dualling – Glen Garry to Dalraddy, Project 9 Crubenmore to Kincaig – Draft Final Report on Preliminary Ground Investigation*' (BAM Ritchies, July 2018), respectively.

Impact Assessment

10.2.13 The potential impacts in relation to geology, soils, groundwater and potential contamination have been assessed individually as per the methodologies provided below. The criteria outlined are based on those that have been applied to similar schemes in Scotland and are designed to comply with DMRB Stage 3 EIA requirements.

Geology and Soils

10.2.14 For superficial and solid geology, soils, designated geological receptors, features of geodiversity interest and mineral extraction, the sensitivity and magnitude criteria in **Table 10-1** and **Table 10-2** were applied. The impact significance was then determined using **Table 10-3**.

10.2.15 In relation to soils and peat, the criteria for defining sensitivity was initially informed based on environmental designations, SNH priority peatland class and Land Capability for Agriculture (LCA) categories, but refined based on field survey data where possible. Soil conservation value is recognised based on rarity, representivity and diversity in the Cairngorms National Park (CNP) (Towers *et al.*, 2005), with overall functional value of these and the underlying superficial and solid geology given indirect cross-topic consideration in the context of potential agricultural land use, ecology, geodiversity, hydrogeology and flooding impacts where necessary.

Table 10-1: Sensitivity Criteria for Geology and Soils

Sensitivity	Assessment Criteria
High	<p>Areas containing geological or geomorphological features considered to be of a national interest such as Sites of Special Scientific Interest (SSSI), candidate SSSI or Geological Conservation Review (GCR) sites</p> <p>Presence of extensive areas of economically important minerals valuable as a national resource</p> <p>Presence of high quality topsoil or soils (typically indicated by LCA Class 1 and Class 2)</p> <p>Areas of peatland within designated sites such as SSSI, Special Area of Conservation (SAC) or Special Protection Area (SPA) with national or European importance and/ or SNH priority peatland Class 1 (nationally important carbon-rich and peaty soils, deep peat and priority peatland habitat likely to be of high conservation value) and Class 2 (nationally important carbon-rich and peaty soils, deep peat and priority peatland habitat likely to be of potentially high conservation value and restoration potential)</p>
Medium	<p>Areas containing geological features of designated regional importance considered worthy of protection for their educational, research, historic or aesthetic importance, such as Local Geodiversity Sites (LGS)/ Regionally Important Geological Sites (RIGS) of national/ regional importance</p> <p>Presence of areas of economically important minerals of regional value</p> <p>Presence of medium quality topsoil or soils (typically indicated by LCA Class 3 and Class 4)</p> <p>SNH priority peatland Class 3 (dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type. Occasional peatland habitats can be found. Most soils are carbon-rich and peaty soils, with some areas of deep peat)</p>
Low	<p>Sites and geological features not currently identified as SSSI, GCR or LGS/ RIGS but that may require protection in the future</p> <p>Presence of mineral areas or resource of local importance only</p> <p>Presence of low quality topsoil or soils (typically indicated by LCA Class 5 and Class 6)</p> <p>SNH priority peatland Class 5 (soil information takes precedence over vegetation data and there is no peatland habitat recorded, but all soils may be carbon-rich and deep peat)</p>
Negligible	<p>Geological features not currently protected and unlikely to require protection in the future</p> <p>No exploitable minerals or geological resources</p> <p>Presence of very low quality topsoil or soils (typically indicated by LCA Class 7).</p> <p>SNH priority peatland Class 4 (areas unlikely to be associated with peatland habitats or wet and acidic type, and unlikely to include carbon-rich or peat soils), Class 0 (mineral soils where peatland habitats are not typically found), Class -1 (unknown soil types) and Class -2 (non-soil (i.e. loch, built up area, rock and scree))</p>

Table 10-2: Impact Magnitude Criteria for Geology and Soils

Magnitude	Assessment Criteria
Major	<p>Partial (greater than 50%) or total loss of a geological site or mineral deposit, or where there would be complete severance of a site such as to affect the value of the site/ resource</p> <p>Major or total loss of topsoil, soils or peatland, or where the value of the area would be severely affected</p>
Moderate	<p>Loss of part of a geological/ geodiversity site or mineral deposit, major severance, major effects to the setting, or disturbance such that the value of the site would be affected, but not to a major degree</p> <p>Partial loss of topsoil, soils or peatland, or where the value of the area would be affected, but not to a major degree</p>
Minor	<p>Small effect on a geological/ geodiversity site or mineral deposit (up to 15%) or a medium effect on its setting, or where there would be a minor severance or disturbance such that the value of the site would not be affected</p> <p>Partial loss of topsoil, soils or peatland, or where soils will be disturbed but the value of the area would not be affected</p>
Negligible	<p>Very slight change from geological, mineral and soil baseline conditions</p>

Table 10-3: Matrix for Determination of Impact Significance for Geology and Soils

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

- 10.2.16 Impacts on geology and soils of **Slight/ Moderate** significance and above are considered to be potentially significant in the context of the EIA Regulations, and the level at which mitigation would generally be required or proposed.

Groundwater

- 10.2.17 For groundwater, the assessment considers sensitivity in the context of the known or anticipated hydrogeological conditions, including groundwater receptors. The sensitivity and magnitude criteria for this are shown in **Table 10-4** and **Table 10-5** respectively. The impact significance was then determined using the matrix as shown in **Table 10-6**.
- 10.2.18 The criteria for defining the magnitude of impact on the quality, level and flow of groundwater is based primarily on the type of proposed road profile (cutting, widening or embankment) facing the receptor, vulnerability of the groundwater to disruption and estimates of drawdown and zones of dewatering influence in accordance with '*CIRIA C750 Groundwater Control: Design and Practice, Second Edition*' (CIRIA, 2016) using the Sichardt formula (Powers *et al.*, 2007). Impacts on the quality, level and flow of groundwater may also have effects on GWDTE, surface water, groundwater abstractions and PWS.
- 10.2.19 For GWDTE, the sensitivity criteria have been based on analysis of NVC Survey findings (MacArthur Green, 2015) against '*Land Use Planning System Guidance Note 31 (LUPS-GU31) Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and GWDTE (Version 3)*' (SEPA, 2017). These were used to identify NVC communities as 'potentially' groundwater dependent or not, with additional hydrogeological and ecological consideration of their 'likely' dependence then undertaken to refine this where possible.

Table 10-4: Sensitivity Criteria for Groundwater

Sensitivity	Assessment Criteria
Very High	Groundwater aquifer(s) with very high productivity and/ or Water Framework Directive (WFD) good groundwater quality and quantity status Exploitation of groundwater resource is extensive for public, private domestic and/ or agricultural use (i.e. feeding ten or more properties) and/ or industrial supply Important sites of nature conservation dependent on groundwater as per importance criteria attributed in Chapter 12 or groundwater is considered likely to support wetland vegetation which is highly groundwater dependent Surface water features with hydrological importance to designated sensitive ecosystems of national/ international importance
High	Groundwater aquifer(s) with moderate/ high productivity and/ or WFD good groundwater quality and quantity status Exploitation of groundwater resource is not extensive (i.e. private domestic and/ or agricultural supply feeding less than ten properties) Local areas of nature conservation dependent on groundwater as per importance criteria attributed in Chapter 12 , or groundwater is considered likely to support wetland vegetation which is moderately groundwater dependent Surface water features with hydrological importance to sensitive ecosystems of regional importance

Sensitivity	Assessment Criteria
Medium	<p>Groundwater aquifer(s) with low productivity and/ or WFD variable groundwater quality and quantity status</p> <p>No current known exploitation of groundwater as a resource and aquifer(s) properties make potential exploitation appear unlikely</p> <p>Minor areas of nature conservation with a degree of groundwater dependency, as per importance criteria attributed in Chapter 12</p> <p>Surface water features with some but limited hydrologic importance to sensitive or protected ecosystems of authority area importance</p>
Low	<p>Groundwater aquifer(s) with very low productivity and/ or WFD poor groundwater quality and quantity status</p> <p>No known past or present exploitation of groundwater aquifer(s) as a resource</p> <p>Areas of vegetation with no groundwater dependency</p> <p>Surface water features with minimal/ insignificant hydrological importance to sensitive ecosystems of less than authority area importance</p>

Table 10-5: Impact Magnitude Criteria for Groundwater

Magnitude	Assessment Criteria
Major	<p>Major or long-term change to groundwater aquifer(s) flow, water level, quality or available yield</p> <p>Groundwater resource use is irreparably impacted upon, with a major or total loss of an existing supply or supplies</p> <p>Changes to water table level or quality would result in a major or total change in or loss of a groundwater dependent area, where the value of a site would be severely affected</p> <p>Changes to groundwater aquifer(s) flow, water level and quality would result in major changes to groundwater base flow contributions to surface water and/ or alterations in surface water quality, resulting in a major shift away from baseline conditions such as change to WFD status</p>
Moderate	<p>Moderate changes to groundwater aquifer(s) flow, water level, quality or available yield</p> <p>Groundwater resource use is impacted slightly, but existing supplies remain sustainable</p> <p>Changes to water table level or quality would result in partial change in or loss of a groundwater dependent area, where the value of the site would be affected, but not to a major degree</p> <p>Changes to groundwater aquifer(s) flow, water level and quality would result in moderate changes to groundwater base flow contributions to surface water and/ or alterations in surface water quality, resulting in a moderate shift from baseline conditions that may be long-term or temporary</p>
Minor	<p>Minor changes to groundwater aquifer(s) flow, water level, quality or available yield</p> <p>Changes to water table level, quality and yield result in little discernible change to existing resource use</p> <p>Changes to water table level or quality would result in minor change to groundwater dependent areas, but where the value of the site would not be affected</p> <p>Changes to groundwater aquifer(s) flow, water level and quality would result in minor changes to groundwater base flow contributions to surface water and/ or alterations in surface water quality, resulting in a minor shift from baseline conditions (equivalent to minor but measurable change within WFD status)</p>
Negligible	Very slight change from groundwater baseline conditions, approximating to 'no change' conditions

Table 10-6: Matrix for Determination of Impact Significance for Groundwater

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

10.2.20 Impacts on groundwater and associated receptors of **Moderate** significance and above are considered to be potentially significant in the context of the EIA Regulations, and the level at which mitigation would generally be required or proposed.

Potential Contamination

- 10.2.21 The assessment of potential contamination has focused on the potential for impacts on receptors as a direct consequence of the Proposed Scheme encountering contamination, within the context of a preliminary conceptual site model (CSM). A receptor can be a person (construction or maintenance workers, road users or local residents), the water environment (groundwater and surface water features), ecological receptors (GWDTE, agricultural land or livestock) and/ or property (structures, buried concrete, services and PWS).
- 10.2.22 The preliminary CSM represents an outline of potential ‘pollutant linkages’ (PL) that may be present between a source of contamination, pathways by which it may move and ultimately, affected receptors. Should any element of that linkage (contaminant, pathway or receptor) be missing or removed, the contamination is considered unlikely to represent a potential risk or impact. The potential receptors and pathways were compiled based on the definitions provided in the ‘*Environmental Protection Act 1990: Part IIA Contaminated Land - Statutory Guidance: Edition 2*’ (Scottish Executive, 2006).
- 10.2.23 Potential contamination sources are identified in the baseline information and the pathways and receptors used in the assessment of these are provided in **Table 10-7**, with individual references for each linkage during construction (PL1 to PL12) and operation (PL13 to PL24).

Table 10-7: Potential Pollutant Linkages for Potential Contamination

Pollutant Linkage	Receptor	Pathway
Construction		
PL1	Human Health (construction workers)	Ingestion, inhalation and dermal contact with soil, soil dust and fibres (asbestos), deep and shallow groundwater and surface water
PL2		Migration of ground gases into shallow pits or site buildings
PL3	Human Health (local residents and transient traffic (foot, road and rail)) Property (Scheduled Monuments (SM), buildings)	Ingestion, inhalation and dermal contact with wind-blown dust created during excavation works
PL4		Migration of ground gases into homes or workplaces through preferential pathways created during construction posing a potential asphyxiation/ explosion risk
PL5	Water Environment (superficial groundwater)	Leaching and migration of contaminants
PL6	Water Environment (bedrock groundwater)	Migration of contaminants or contaminated shallow groundwater into the deeper rock aquifer
PL7	Water Environment (surface water) Ecological Receptors (GWDTE) Property (PWS and services)	Migration/ mobilisation of contaminated shallow groundwater through drift deposits or made ground
PL8	Water Environment (surface water)	Runoff from contaminated source(s)
PL9		Migration of contaminated bedrock groundwater towards surface water receptor
PL10		Discharge of intercepted contaminated groundwater during passive or active dewatering
PL11	Ecological receptors (agricultural land/ livestock)	Inhalation, ingestion and direct contact with contaminated soils, soil dust, fibres (asbestos) and water
PL12	Property (SM, buried concrete and services)	Direct contact with made ground, superficial deposits, groundwater and bedrock materials
Operation		
PL13	Human Health (maintenance workers)	Ingestion, inhalation and dermal contact with soil, soil dust, fibres (asbestos), deep and shallow groundwater, surface water in the long-term during routine maintenance e.g. drainage inspections

Pollutant Linkage	Receptor	Pathway
PL14	Human Health (maintenance workers)	Migration of ground gases into confined spaces e.g. service pits, accommodation buildings creating an asphyxiation/explosion risk
PL15	Human Health (local residents and transient traffic (foot, road and rail)) Property (SM and buildings)	Ingestion, inhalation and dermal contact with wind-blown dust from contaminated soils re-used within road features such as embankments and landscaped areas
PL16		Migration of ground gases into homes or workplaces through preferential pathways remaining following construction thus posing a potential asphyxiation/ explosion risk
PL17	Water Environment (superficial groundwater)	Leaching and migration of contaminants
PL18	Water Environment (bedrock groundwater)	Migration of contaminated shallow groundwater into the deeper rock aquifer
PL19	Water Environment (surface water) Ecological Receptors (GWDTE) Property (PWS and services)	Migration of shallow groundwater through drift deposits or made ground
PL20	Water Environment (surface water)	Runoff from contaminated source(s)
PL21		Migration of contaminated shallow groundwater through drainage channels and associated granular bedding materials or engineered structures
PL22		Discharge of intercepted contaminated groundwater
PL23	Ecological receptors (agricultural land/ livestock)	Inhalation, ingestion and direct contact with contaminated soils, soil dust, fibres (asbestos) and water
PL24	Property (buried concrete and services)	Direct contact with made ground, superficial deposits, groundwater and bedrock materials

10.2.24 For the purposes of the assessment, the preliminary CSM disregards pollutant linkages that are incomplete and cannot pose a risk to identified receptors. Where a complete pollutant linkage may exist, a generic qualitative risk assessment has been undertaken.

10.2.25 The output of the assessment cannot be reported in terms of ‘sensitivity’. Instead, it is reported as the ‘likelihood’ of a complete pollutant linkage being present, which is defined within CIRIA C552 ‘Contaminated Land Risk Assessment: A Guide to Good Practice’ (CIRIA, 2001), ‘CLR11 – Model Procedures for the Management of Land Contamination’ (Environment Agency, 2004) and summarised in **Table 10-8**. The magnitude (consequence) of the effect on likely receptors is outlined in **Table 10-9** and overall risk (significance), taking account of both likelihood and consequence, is identified with reference to the matrix in **Table 10-10**.

Table 10-8: Likelihood Criteria for Potential Contamination

Likelihood	Assessment Criteria
High Likelihood	There is a complete pollution linkage and an event that either appears very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution
Likely	There is a complete pollution linkage and all the elements are present and available, which means that it is probable that an event will occur Circumstances are such that an event is not inevitable, but possible in the short-term and likely over a long-term
Low Likelihood	There is a complete pollution linkage and the circumstances are possible under which an event could occur However, it is by no means certain that even over a longer period such an event would take place, and is less likely in the shorter term
Unlikely	There is a complete pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long-term

Table 10-9: Impact Magnitude (Consequence) Criteria for Potential Contamination

Consequence	Assessment Criteria
Severe	Short-term (acute) damage to human health (significant harm) Pollution of sensitive water resources as a result of short-term exposure Damage to a particular ecosystem as a result of acute exposure Catastrophic damage to buildings/ property/ services/ Scheduled Monument (SM)
Medium	Long-term (chronic) damage to human health (significant harm) Pollution of sensitive water resources as a result of chronic exposure A significant change in a particular ecosystem, or organism forming part of such an ecosystem Substantial damage to buildings/ property/ services/ SM
Mild	No appreciable impact on human health based on the potential effects on the critical human health receptor Pollution of non-sensitive water resources Damage to ecological systems with no significant impairment Significant damage to sensitive buildings/ structures/ SM/ services or the environment
Minor	Harm (not necessarily significant), which may result in financial loss or require expenditure to resolve Non-permanent health effects to human health No appreciable pollution Easily repairable effects or damage to ecological systems Easily repairable damage to buildings, structures, SM and services

Table 10-10: Matrix for Determination of Impact Significance (Risk) for Potential Contamination

Consequence	Likelihood			
	High likelihood	Likely	Low likelihood	Unlikely
Severe	Very high	High	Moderate	Moderate/ Low
Medium	High	Moderate	Moderate/ Low	Low
Mild	Moderate	Moderate/ Low	Low	Very Low
Minor	Moderate/ Low	Low	Very Low	Very low

10.2.26 Impacts of **Moderate/ Low** significance and above in relation to potential contamination are considered to be potentially significant in the context of the EIA Regulations, and the level at which mitigation would generally be required or proposed.

Limitations to Assessment

10.2.27 Information from both the Advanced GI and Preliminary GI works has been used in the assessment. In areas where no data is available, geological and hydrogeological information has been extrapolated or used from the nearest available data points. Groundwater monitoring for the Preliminary GI is scheduled for completion by January 2019. Monitoring results available from between January and June 2018 have been taken into account in the assessment.

10.2.28 Groundwater abstraction and PWS features have been identified based on information supplied by THC, SEPA, HighWater (Scotland) Ltd, landowner/ resident consultations, historical or current mapping and site walkovers (CFJV, March, August and November 2017). Additional consultations may be required as part of the detailed design and pre-construction activities.

10.2.29 In certain conditions, groundwater dewatering effects have the potential to cause differential ground settlement. This is a geotechnical consideration, outwith the scope of this EIA. However, mitigation is included for an assessment of this to be completed prior to construction in areas of excavation located nearby existing infrastructure, properties or cultural heritage receptors. This

will be supported by the complete groundwater monitoring dataset from the Preliminary GI, as well as data from Detailed and Supplementary GI, scheduled for completion in 2018 and 2019.

- 10.2.30 The identification of potential contamination sources has been reliant on the accuracy of historical mapping and available GI. Potential sources not encountered during GI or identified through desk-based assessment and consultation are not reported. The assessment of historical quarrying activity has also been based on a desk-based review of historical mapping. It is possible that quarrying works could have been undertaken and the void backfilled between the recorded years of mapping, such that no map evidence exists.

10.3 Baseline Conditions

Geology

- 10.3.1 As shown in **Drawing 10.1 (Volume 3)**, published BGS mapping indicates the superficial deposits within the study area to variably include made ground, peat, alluvium, alluvial fan deposits, river terrace deposits, head, glaciofluvial deposits, till, hummocky glacial and lacustrine deposits.
- 10.3.2 The solid geology throughout the majority of the study area comprises Precambrian Psammite of the Loch Laggan Psammite Formation; recorded as micaceous and feldspathic psammite with thin semi-pelite beds and possible calc-silicate rock lenses and bands. The regional limit of pegmatitic rock veins runs parallel with much of the existing A9 carriageway, crossing it at approximate chainage (ch.) 43,750, ch. 51,000 and ch. 52,600. As shown in **Drawing 10.2 (Volume 3)**, BGS mapping also indicates the Gaick Psammite and Torr Na Truim Semipelite Formations between 50m and 100m to the north east and south west of the existing A9 in the southern extents of the study area, together with local faulting crossing the carriageway at ch. 42,250. These strata comprise fine-grained quartzose with some biotite laminae and semipelite composed of muscovite, biotite, quartz and feldspar schistose and locally gneissose.
- 10.3.3 The conditions recorded by available GI information are summarised below. Findings in relation to peaty soils and peat are described in **Appendix 10.1 (Volume 2)** and the soils sub-section.

Made Ground

- 10.3.4 As shown in **Drawing 10.1 (Volume 3)**, BGS mapping indicates areas of made or worked ground at several locations in the study area – which appear to be associated with historical/ recent mineral extraction activities and other development. In this respect, worked ground is shown underlying the Proposed Scheme area at Ralia (ch. 42,000 to ch. 42,500), to the north west of the Bridge of Inverton (ch. 47,375 to ch. 47,725), adjacent to the south east and 100m north west of Kingussie junction (ch. 50,750 to ch. 50,950 and ch. 50,050 to ch. 50,200). Areas of made ground are also indicated nearby the Proposed Scheme at Meadowside Quarry (ch. 56,300 to ch. 56,700) and 225m south east at Ruthven Barracks (ch. 49,500).
- 10.3.5 Made ground associated with the existing road and other nearby developments has been recorded at several locations during previous GI for the original A9 construction, the existing dual carriageway at Crubenmore, the Advanced GI and Preliminary GI. The materials were observed to range from 0.10 to 7.50m in thickness and described to vary between gravelly or clayey gravelly sand and peaty or clayey gravelly topsoil and dense sand, gravel, cobble, concrete and locally ash fill with tarmac. The materials are present from ground level, with the maximum thickness of 7.50m observed at ch. 49,900, associated with the approach embankment for the existing River Spey bridge, which is approximately 5.00 to 8.00m in height.
- 10.3.6 Extraneous materials including old concrete pipe fragments, inclusions of wood, concrete, glass or metal and traces of rubbish, foil and plastic bags were observed in the made ground during the

Advanced GI and Preliminary GI at several locations. Organic odours were also noted in locations nearby Glen Truim (ch. 40,700), Ralia (ch. 42,200 and ch. 42,400), Raliabeag (ch. 42,900), Drumnanoich (ch. 47,260), Ruthven (ch. 48,900 and ch. 49,150), Kerrow (ch. 50,900) and Balavil (ch. 51,900).

- 10.3.7 Based on **Table 10-1**, made ground is considered to be of **negligible** sensitivity. However, each individual occurrence has been reviewed as a potential contamination source in **Appendix 10.4 (Volume 2)** and their locations are shown in **Drawings 10.35 to 10.46 (Volume 3)**.

Superficial Geology

- 10.3.8 Superficial soils from available GI have been observed to be locally absent (where bedrock is at the surface), but otherwise predominantly comprise glaciofluvial deposits throughout the Proposed Scheme. Till and hummocky glacial deposits are present to the south and east across central and southern areas, with river terrace, alluvial, alluvial fan and glaciolacustrine deposits associated with the River Truim and River Spey floodplains, Insh Marshes and various watercourses in southern and northern extents.
- 10.3.9 Glaciofluvial deposits were generally described as loose to very dense fine to coarse sand and/ or fine to coarse gravel or sandy gravelly clay with variable cobble content. These were observed to range between 0.65 and at least 34.20m in thickness, with the greatest thickness encountered near the existing River Spey bridge (ch. 50,200). Although typically granular, silt layers were also recorded in the glaciofluvial deposits, appearing to be concentrated in, but not limited to, central portions of the Proposed Scheme from near Drumnanoich to just north of Kingussie. These finer materials were interlayered with granular sands and gravels. Fine black organic fragments, roots and peat pockets are also present locally, at shallow and greater depths.
- 10.3.10 Glacial deposits, including till and local hummocky glacial deposits, were generally described as granular; comprising medium dense to very dense silty gravelly fine to coarse sand and/ or silty sandy fine to coarse gravel with variable cobble content, some clay and silt layers, and local pockets of peat and roots. The recorded thickness of the glacial deposits varies between 0.60 and at least 26.50m across southern extents of the Proposed Scheme, with the greatest thickness observed at Ralia Moss near the existing Newtonmore junction (ch. 43,150).
- 10.3.11 Alluvial and river terrace deposits are predominant on the northern/ western sides of the existing A9 in the southern extents of the Proposed Scheme and on the southern/ eastern sides in the north, with alluvial fans deposits near Laggan Cottage, north of Lynchat and adjacent to Balavil Cottage. These deposits were observed to be generally granular, comprising medium dense to very dense silty gravelly fine to coarse sand and/ or fine to coarse gravel with variable cobble and boulder content, but layers of sandy gravelly silt were also observed locally near Lynchat. The thickness of the materials generally ranged between 0.70m and 28.50m, with the greatest thicknesses observed south of Newtonmore, and in the River Spey floodplain and Insh Marshes.
- 10.3.12 Glaciolacustrine deposits were encountered to the south and east of the existing A9 carriageway south of Kincaig and in areas within the River Spey floodplain and Insh Marshes, typically underlying and interlayered with glaciofluvial and alluvial deposits. The majority of the materials were observed to comprise sandy silts, silty sands or sandy gravelly clay, with some interlayered gravel, and were recorded to range between 2.05 and 62.25m in thickness. Blowing sands were also recorded at depth in the glaciolacustrine deposits within the River Spey floodplain and Insh Marshes, appearing to be indicative of a sub-artesian groundwater regime within these.
- 10.3.13 Based on **Table 10-1**, the superficial deposits are considered to be of **negligible** sensitivity.

Solid Geology

- 10.3.14 The available GI information has identified depth to bedrock to range from being visible on the ground surface in southern extents of the Proposed Scheme, and up to 93.50m bgl within the River Spey floodplain and Insh Marshes. The rock observed is predominantly composed of psammite, semi-pelite, and schist, frequently interlayered and described as medium strong to very strong, locally weak with some heavy fracturing.
- 10.3.15 Partial or distinct weathering was identified in the form of red, pink and green staining or silty/clay smearing on fracture surfaces, while pegmatite with lenses of pyrite was also encountered near Ralia Lodge (ch. 43,650) and the Bridge of Inverton (ch. 47,700). Granite was found in two locations, south of the proposed Newtonmore junction (ch. 43,250) and was described as strong, locally medium strong with medium spaced fractures and no evidence of weathering.
- 10.3.16 Based on **Table 10-1**, solid geology in the study area is considered to be of **negligible** sensitivity.

Designated Geological Receptors and Features of Geodiversity Interest

- 10.3.17 No geological SSSI, GCR or LGS sites are present in the study area. However, consultation with SNH highlighted Lochan an Tairbh as a site of important geodiversity interest (Transport Scotland, 2014a), while three areas of exposed rock have been identified adjacent to the existing A9 carriageway. Details of these features are provided below and their locations are shown in **Drawing 10.3 (Volume 3)**.

Lochan an Tairbh

- 10.3.18 Lochan an Tairbh is located to the immediate north of the existing A9 between ch. 47,800 and ch. 48,050. It comprises a water-filled kettle hole, measuring approximately 190m in length and 95m in width, and is likely to have formed during the final stages of the ice-sheet deglaciation through melting of stagnant ice buried by out washed glacial and fluvial sand and gravel deposits.
- 10.3.19 As shown in **Photograph 10.1**, the lochan is surrounded by kames (mounds of sand and gravel deposited by melting ice) among a wider outwash plain (sediment deposited by meltwater outwash at the terminus of a glacier), and represents an almost completely undisturbed and intact 'kame and kettle' landform, though there are some adjacent areas of plantation woodland.

Photograph 10.1: Lochan an Tairbh (ch. 47,800 to ch. 48,050)



- 10.3.20 No exposures or slumping are evident on the landforms in the area. However, available GI information in the vicinity indicates the stratigraphy to comprise glaciofluvial sands and gravels.
- 10.3.21 The site is important because it exhibits a classic example of intact kame and kettle terrain, and is one of the best examples of this anywhere in Britain (Transport Scotland, 2014a). In wider context, the area also is sharply distinguishable from a younger alluvial terrace to the north, which is likely to have been formed by the River Spey during the final retreat of the last ice-sheet and subsequent Loch Lomond Readvance. Taken together with sediments potentially preserved in the lochan, the site is likely to be important for interpretations of glacial recession in the area.
- 10.3.22 Based on the above and previous consultation, the site is considered to be regionally important (Transport Scotland, 2014a) and although not currently identified as a SSSI, GCR or LGS qualifying feature; it may be considered worthy of protection for its educational, research, historic or aesthetic importance in the future. On balance and based on the criteria in **Table 10-1**; Lochan an Tairbh is therefore considered to be of **medium** sensitivity.

Rock Exposures

- 10.3.23 As illustrated in **Drawing 10.3 (Volume 3)**, three areas of exposed rock are present within existing road cuttings on the A9. Field mapping visits (CFJV, 2016 and 2017) have assigned the following references and recorded the exposures as:
- **P09-RE01:** Greenish grey and pale brown medium strong psammite which is locally schistose with quartz veins. A distinct light grey foundation at the base of the exposure is also present. Southbound carriageway (ch. 43,650 to ch. 43,900), approximately 5.00 to 12.00m in height and 80-100% exposure.
 - **P09-RE02:** Dark grey to light grey medium strong to strong psammite with quartz veins and areas of highly deformed with foliation clearly visible in the rock face. Southbound carriageway (ch. 44,750 to ch. 45,020), approximately 3.00 to 15.00m in height and 80-100% exposure.
 - **P09-RE03:** Dark grey and greenish grey strong to very strong psammite and schistose in areas with quartz veins, variable foliation is also visible throughout the rock face. Northbound carriageway 200m north of the Proposed Scheme approximately 2.00 to 6.00m in height and 60-70% exposure.
- 10.3.24 An additional area of existing rock cutting is present on the northbound carriageway (ch. 45,200 to ch. 45,700), but is wholly concealed by vegetation. Based on the criteria in **Table 10-1**, this and the exposures above are considered to be of **negligible** sensitivity, as they are not currently protected and are unlikely to require protection in the future. The rock types and structures are also widespread across the region and similar exposures exist elsewhere.

Mineral Extraction

- 10.3.25 BGS mapping and mineral resources publications indicated that the study area did not contain historical areas of coal mining. However, there is evidence of current and historical rock, sand and gravel mineral extraction.
- 10.3.26 Meadowside Quarry is located 85m north of the existing A9 between approximate ch. 56,250 and ch. 56,650 on the outskirts of Kincaig, and is an operational opencast site for the extraction of igneous and metamorphic rock. The site is currently operated by Breedon Aggregates and has been identified as a potential contamination source (CK-39) in **Appendix 10.4 (Volume 2)**, with its location shown on **Drawing 10.46 (Volume 3)**.

- 10.3.27 Several other historic quarries, gravel or sand pits were also identified within 250m of the Proposed Scheme as shown in **Drawings 10.35 to 10.46 (Volume 3)**. Individual review of these based on historical mapping and/ or information received from THC in **Appendix 10.4 (Volume 2)** suggests these related to sand and gravel extraction within the superficial soils, and they are observed to correspond to areas of made/ worked ground identified on BGS mapping at Ralia (ch. 42,000 to ch. 42,500) and Meadowside (ch. 56,250 to ch. 56,650).
- 10.3.28 Based on the above, there is potential for further rock, sand and gravel resources to be available in the study area. However, any future exploitation would be expected to be of local importance only, and is therefore considered to be of **low** sensitivity based on the criteria in **Table 10-1**.

Soils

- 10.3.29 The soils present within the study area have been identified using BGS mapping, the National Soil Map of Scotland (1:250,000 scale) (JHI, 2013), LCA maps (JHI, 1983), available GI and publications related to Scotland's soils and their conservation value.

Soil Conservation

- 10.3.30 As illustrated in **Drawings 10.4 and 10.5 (Volume 3)**, the majority of the study area is underlain by humus-iron podzols, typically with some peat, peaty gleys, humic gleys, peaty podzols and peaty gleyed podzols. Mineral alluvial soils with peaty alluvial soils are predominant in areas underlying and adjacent to the River Spey floodplain and Insh Marshes. The soil types are derived from metamorphic rock, fluvioglacial sands and gravels, recent riverine and lacustrine alluvial deposits, and in the case of peats, accumulations of organic material.
- 10.3.31 Humus-iron podzols are well represented in the CNP in comparison to the rest of Scotland, but they are not considered to be rare. Mineral alluvial and peaty alluvial soils underlying and associated with wetland areas of the River Spey floodplain and Insh Marshes would typically be expected in such environments, but they are also relatively rare within the CNP context (Towers *et al.*, 2005), together with the floodplain fen and mire complex habitats they support.
- 10.3.32 Studies of soil conservation value in the CNP (Towers *et al.*, 2005) generated conservation index values of between 100 and 200 for the humus-iron podzols and mineral alluvial soils in the study area. This indicates these are of **medium** soil conservation interest, though is based solely on rarity, representivity, and diversity. In real terms, it is recognised that overall soil conservation (functional) value will vary, with them providing a range of ecological services and functions at a local scale and in wider environmental frameworks, including for example, areas in the River Spey – Insh Marshes Ramsar, SPA and SSSI and Insh Marshes SAC and National Nature Reserve (NNR).

Agricultural Soil Productivity

- 10.3.33 Several parts of the study area are currently utilised for agricultural purposes, with some areas also used for sporting interests associated with the Phoinies and Ralia Estates, as described in **Chapter 8**. As shown on **Drawings 8.9 to 8.14 (Volume 3)**, the predominant LCA Classes in the study area are 5.2 (improved grassland) and 4.1 to 4.2 (mixed agriculture), which are respectively considered to be of **low** and **medium** sensitivity in terms of agricultural soil productivity based on the criteria in **Table 10-1**.
- 10.3.34 Areas of LCA Class 6.2 (rough grazing) are also present to the south and east, in central and northern portions of the study area through the Insh Marshes (ch. 49,000 to ch. 56,600), with areas of LCA Class 3.2 (mixed agriculture) near Newtonmore. These classifications are also considered to be of **low** and **medium** sensitivity, respectively, based on the criteria in **Table 10-1**.

Peat

- 10.3.35 As shown in **Drawing 10.1 (Volume 3)**, BGS mapping identifies scattered areas of peat in the study area. The majority of these are located south and east of the existing A9 carriageway, starting at ch. 40,000 and continuing to ch. 44,000, along with two smaller areas to the north near Raliabeag. The remaining areas are located to the north and west of Kingussie, between ch. 50,200 and ch. 56,645, with an additional area directly south of the existing A9 between ch. 51,600 and ch. 52,200. Published soil mapping shown in **Drawings 10.4 and 10.5 (Volume 3)** also identifies areas of peaty soils, including peaty gleys, peaty podzols, peaty gleyed podzols and peaty alluvial soils to be present.
- 10.3.36 SNH Carbon and Peatland mapping (SNH, 2016) shown in **Drawing 10.6 (Volume 3)** indicates that there are no areas of priority peatland in the study area, and it predominantly comprises Class 0 (mineral soils where peatland habitats are not typically found) throughout. However, field surveys were undertaken and considered in conjunction with Phase 1 Habitat (CH2M, 2014) and NVC Surveys (MacArthur Green, 2015) to develop a higher resolution understanding of peaty soil and peat presence, depth and characteristics. These surveys and their findings are described in **Appendix 10.1 (Volume 2)**, and were used to create a peat depth model for the Proposed Scheme and adjacent areas, as shown in **Drawings 10.11 to 10.22 (Volume 3)**.
- 10.3.37 Ecology surveys have identified peatland and heathland habitats within the study area, with peat-forming vegetation types including fens, marsh, mire, blanket mire and wet heaths, or mosaics of these as shown in **Drawings 12.8 to 12.27 (Volume 3)** and described in **Chapter 12**. Dry heaths and other semi-natural vegetation, such as grasslands, are also present.
- 10.3.38 Peaty soils and topsoil (less than 0.50m thickness) are predominant throughout the Proposed Scheme in areas of dry or wet heath, mosaics of these and grassland transitions. Discontinuous pockets of shallow peat (between 0.50m and 1.00m thickness) are present in similar areas locally, with some areas of deep peat (greater than 1.00m thickness) also occurring in areas of wet heath, blanket bog, mosaics of these, other mires, fens, marshes and swamp. Peaty soil and peat depths across the Proposed Scheme ranged from 0.00 to 4.85m, while available GI has also identified peat strata, between 0.10 and 3.30m thickness, buried beneath granular horizons of made ground and/or sands and gravels at several locations.
- 10.3.39 The basic peat characteristics across the study area are considered in **Appendix 10.1 (Volume 2)**. This identifies the majority of areas to be affected by artificial drainage; associated with existing or recent infrastructure or areas utilised for agricultural purposes. As a result, the majority of peat areas within the Proposed Scheme extents may be considered as degraded. However, some shallow and deep peat in areas of wet heath, blanket bog, other mires, fen, marsh and swamp within and adjacent to the Proposed Scheme at Newtonmore, Nuide and across the Insh Marshes appear sufficiently wet and/or contain bog pool communities indicative of good condition. Some of the associated habitats and vegetation identified are also recognised under Annex 1 of the European Council Habitats Directive 92/43/EEC (Council of the European Communities, 1992), the Scottish Biodiversity List (Scottish Government, 2013) and Cairngorms Nature Action Plan (CNPA, 2013), while additionally being present within or connected to habitats in the River Spey – Insh Marshes Ramsar, SPA and SSSI or Insh Marshes SAC and NNR.
- 10.3.40 Based on the above and the criteria in **Table 10-1**, the habitats and vegetation suggest that several areas of peaty soil and peat across the Proposed Scheme would be considered **medium** or **high** sensitivity, for one or more reasons. Such areas are reasonably indicated through the distribution of blanket bog, wet heath, mosaics of these, other mires, fen, marsh and swamp shown in **Drawings 12.8 to 12.27 (Volume 3)**; as these correspond to the areas and pockets of deepest peat and otherwise, areas of higher conservation value. The remaining areas of peaty

soils and topsoil mostly correspond to occasionally wet, but predominantly dry, acidic and more fragmented areas of dry heath, wet heath and grassland/ open vegetation transition types. These are not considered to represent priority peatland and are otherwise, areas of generally lower conservation interest which would be considered **low** or **negligible** sensitivity.

Groundwater

- 10.3.41 The groundwater characteristics of the study area are summarised below, based on information obtained from BGS and SEPA publications, available GI information and previous reports.

Hydrogeology

- 10.3.42 The SEPA River Basin Management Plan (RBMP) interactive map (SEPA, 2018) indicates the study area is primarily underlain by the Upper Spey bedrock and localised sand and gravel aquifers, with areas surrounding and underlying the River Spey comprising the Spey Valley (upstream of Kingussie) and Upper Spey Valley sand and gravel aquifers. The Truim and Tromie Valley sand and gravel aquifers are also present where the River Truim and River Tromie confluence with the River Spey in the south towards Crubenmore and in the north at the Insh Marshes, respectively. The WFD classification from 2008 for groundwater in both the superficial and bedrock deposits is 'good' with 'high' confidence for both quantity and quality, with no trend for pollutants and no current pressures.
- 10.3.43 As shown in **Drawing 10.7 (Volume 3)**, glacial (till and hummocky moundy glacial deposits) and lacustrine deposits in the south and north of the study area do not comprise significant aquifers. However, glaciofluvial deposits are indicated as high productivity, while alluvial, alluvial fan and river terrace deposits are moderate to high productivity with intergranular flow. Bedrock throughout the study area is classified as very low or low in productivity, as shown in **Drawing 10.8 (Volume 3)**, with groundwater storage and flow likely limited to near surface weathered zones and fractures.
- 10.3.44 Groundwater flow in the superficial deposits is likely to follow surface topography towards local surface watercourses. However, flows may be locally complex and influenced by the presence of peat, shallow rock and man-made features associated with the existing A9 carriageway, Highland Mainline railway, tracks, structures and artificial drainage.
- 10.3.45 The hydrogeology of the Insh Marshes is known to be specifically varied and complex, with the existence of different 'compartments' (**Drawing 12.40 (Volume 3)**) that vary in hydrological regime, including water table and ditch water levels, as well as direction and rate of groundwater flows (Royal Society for the Protection of Birds (RSPB) Scotland, 2007). A complex range of water supply mechanisms and interactions (groundwater recharge and discharge, groundwater flows to and from the River Spey or drainage ditches, surface water flow and recharge from the River Spey, precipitation and surface water flows from upland areas) therefore influence the marshes, and previous studies of water table depths in relation to NVC vegetation types has shown that these depend on the depth of the water table (RSPB Scotland, 2007). Sand rising up the casing and blowing sands were also recorded at depth within the superficial deposits in the River Spey floodplain and Insh Marshes during the Advanced GI and Preliminary GI, appearing to be indicative of a sub-artesian groundwater regime within these.
- 10.3.46 The flow direction of bedrock groundwater is unconfirmed, but is likely to follow the direction of local surface watercourses and may be locally discontinuous due to fracturing and folding.
- 10.3.47 Based on the criteria in **Table 10-4**, the hydrogeological characteristics and sensitivity of the superficial and solid geology units within the study area are summarised in **Table 10-11**. This is based on combined consideration of productivity, WFD classifications for quality and quantity,

and available GI information related to groundwater levels and quality. As such, the sensitivities assigned are applicable to groundwater quality, levels and flow.

Table 10-11: Hydrogeological Characteristics and Sensitivity of Superficial and Solid Geology Units

Geological Unit	Geological Characteristics	Hydrogeological Characteristics	Sensitivity
Made Ground	Clayey sandy, gravelly topsoil, sandy gravelly clay and sand with concrete, cobbles, boulders and pockets of peat.	Assumed poor groundwater potential due to localised occurrence and surface/ near surface location, likely variable permeability and perched nature.	Low
Peat	Variable from insignificant to strongly decomposed and of variable type, condition, fibre and water content.	Low value in terms of resource and productivity, but likely variable permeability (depending on decomposition) and variable water contents from rainfall, run-off and groundwater with a variety of important functional roles.	Medium
Glaciofluvial Deposits	Clayey, silty and sandy fine to coarse gravel.	Generally high productivity with intergranular flow and good quality and quantity status in the Upper Spey bedrock and localised sand and gravel aquifers, Truim Valley, Spey Valley and Upper Spey Valley sand and gravel aquifers. Groundwater in glaciofluvial deposits would also be expected to be hydraulically connected to surface waters.	High
Alluvium	Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel.	Moderate to high productivity with intergranular flow and good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers, Truim Valley sand and gravel aquifer, Spey Valley sand and gravel aquifer and Upper Spey Valley sand and gravel aquifer. Groundwater within alluvial deposits would also be expected to be hydraulically connected to surface waters.	High
River Terrace Deposits	Clayey, silty or gravelly fine to coarse sand and silty sandy fine to coarse gravel.		High
Alluvial Fan Deposits	Sandy gravelly silt and silty fine to coarse gravel.		High
Lacustrine Deposits	Soft to firm laminated sandy silt or clay with occasional gravel.	Although mapped and present within the Upper Spey bedrock and localised sand and gravel aquifers with good quality and quantity status, deposits of till, lacustrine and hummocky glacial deposits are predominantly identified as not being a significant aquifer. This may be because of their typically low/ variable permeability, but they have been recorded as predominantly granular and therefore may therefore be locally connected to surface waters, with groundwater presence also likely to be influenced by rainfall and snowmelt.	Medium
Till	Clayey silty sandy fine to coarse gravel and sandy gravelly silt.		Medium
Hummocky Glacial Deposits	Clayey, silty and sandy fine to coarse gravel or clayey, silty gravelly sand.		Medium
Falls of Phones Semipelite Formation	Semipelite, mainly gneissose but locally schistose	Very low productivity with fracture flow and despite good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers, limited spatial extent within study area.	Medium
Gaick Psammite Formation	Predominately quartzose psammite with biotite flakes and laminae	Very low productivity with fracture flow, but good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers with known local abstractions.	Medium
Loch Laggan Psammite Formation	Predominately micaceous and feldspathic psammite with semipelite beds and calc-silicate rock lenses and bands		Medium

Geological Unit	Geological Characteristics	Hydrogeological Characteristics	Sensitivity
Torr Na Truim Formation	Semipelite, composed mainly of muscovite, biotite, quartz and feldspar, schistose and locally gneissose, with bands of psammite, quartzose semipelite and micaceous psammite.	Very low to low productivity with fracture flow and despite good quality and quantity status within the Upper Spey bedrock and localised sand and gravel aquifers, limited spatial extent within study area.	Medium

Groundwater Monitoring

- 10.3.48 Groundwater was encountered in boreholes and trial pit excavations during the Advanced GI and Preliminary GI, with water strikes between ground level and 20.50m below ground level (m bgl) in superficial deposits and at 4.60 and 9.84m bgl in bedrock. Several locations were also recorded as dry.
- 10.3.49 Groundwater monitoring data was collected from 18 borehole locations between January and December 2016 for the Advanced GI, and from 123 boreholes locations (99 standpipes and 24 piezometers) between January and June 2018 for the Preliminary GI. The data collected indicates water levels ranging from ground level to 21.60m bgl, with variable conditions throughout. This equates to piezometric levels of between 213.70 (ch. 50,000 at the Insh Marshes) and 285.41m (ch. 44,900 near Braes of Nuide) Above Ordnance Datum across the Proposed Scheme. The greatest level range recorded in a single borehole during the monitoring to date was 13.09m (ch. 42,350 near Ralia).
- 10.3.50 Sand rising up the casing and blowing sands were recorded at depth in the Insh Marshes, within thick superficial deposits adjacent to where the existing A9 crosses the River Spey. This suggests that there is water under pressure at depth in this area, possibly within a semi-confined aquifer, while shallow groundwater is also likely in the surrounding wetlands of the River Spey floodplain and Insh Marshes. In this respect, the RSPB Scotland report '*Insh Marshes – Its Hydrology, Multiple Uses and Economic Value*' (October, 2007) highlights that the marshes remain wet throughout the year, with a water table rarely below 20 cm beneath the soil surface. It also reports water levels are typically high from October to March, and lowest in June, with previous studies recording evidence of groundwater upwelling on the Insh/ Coull and Balavil sections (**Drawing 12.40 (Volume 3)**); indicating that some areas are groundwater-fed in summer.
- 10.3.51 Particle size distribution testing and published literature values (Freeze and Cherry, 1979; Wheeler, 2009; Natural England, 2010) indicate that variable permeabilities for peat, superficial soils and bedrock in the study area can be expected. Seventeen variable head permeability tests were carried out during the Preliminary GI to provide permeability estimates across the Proposed Scheme. The coefficients of permeability were reported to range between 3.5×10^{-7} and 7.7×10^{-5} metres per second (m/s).

Groundwater Quality

- 10.3.52 The BGS publication '*Scotland's aquifers and groundwater bodies – OR/15/028*' (BGS, 2015) provides an outline of groundwater quality in the Precambrian bedrock underlying the Proposed Scheme. It describes the groundwater as weakly mineralised, with variable redox conditions, calcium as a dominant cation and bicarbonate as a dominant anion, and with nitrate concentrations between 0.15 to 17.46 milligrams per litre (mg/l). The study area is not located in a Nitrate Vulnerable Zone, but is within a Drinking Water Protection Zone.

- 10.3.53 SEPA consultation information indicates there are 50 discharge consent records in the study area, primarily associated with the discharge of septic tank effluent to soakaways and occasionally land or surface watercourses. Details of these are provided in **Appendix 10.4 (Volume 2)**.
- 10.3.54 The results of available soil leachate and groundwater chemical analysis from the Advanced GI and Preliminary GI have been compared against water quality standards for drinking water, surface water and GWDTE in accordance with SEPA Position Statement WAT-PS-10-01 'Assigning Groundwater Assessment Criteria for Pollutant Inputs' (SEPA, 2014). The comparison identified localised elevated concentrations of nitrate and ammoniacal nitrogen within the soil leachate analysis, with detections of some polycyclic aromatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH) also noted. Groundwater results identified similar PAH and TPH detections, together with some localised elevated cadmium, mercury, copper, lead, nitrate and ammoniacal nitrogen.

Groundwater Abstractions and Private Water Supplies

- 10.3.55 Based on consultations with THC and SEPA; 20 PWS source locations were initially identified in the study area, supplying properties throughout the Proposed Scheme extents. Fifteen possible well features were also identified based on current or historical mapping, landowner consultation or site walkovers (CFJV, November 2017). Additional consultations with landowners, residents, HighWater (Scotland) Ltd and site walkovers (CFJV, March, August and November 2017) were then undertaken to obtain further information on the features and to determine their status.
- 10.3.56 The information obtained is described in **Appendix 10.3 (Volume 2)** and summarised in **Table 10-12**. The sensitivity of each feature has been assigned based on the criteria in **Table 10-4**. Where consultation or other information has identified that the PWS or possible wells are not present or are no longer in use (i.e. are abandoned or not active), no sensitivity is assigned and they are not considered to represent receptors. However, where the status or use of a feature is unconfirmed or unclear, it is considered to be of high sensitivity.

Table 10-12: Groundwater Abstractions and Private Water Supplies

Feature Ref.	Feature Type	Chainage (ch.)	Description/ Consultation Details	Sensitivity
ABS 9.1a	Borehole	ch. 40,000	THC information identified a PWS sourced from a spring at Glentruim Estate and Glentruim Farm, used to supply eleven properties for domestic purposes. Landowner consultation confirmed the supply is present, but supplies only five properties. The landowner believes the other properties to be supplied by a spring (ABS 9.1b), outwith their land.	High
ABS 9.1b	Spring	South of Proposed Scheme	Landowner and resident consultation identified a PWS sourced from a spring associated with seven properties at Glentruim Estate. The information received indicates the supply is used for domestic and agricultural purposes.	High
ABS 9.2	Borehole	ch. 40,300	THC and HighWater (Scotland) Ltd information identified a PWS sourced from a borehole adjacent to the River Truim. Landowner consultation confirmed this, and that the borehole is used to supply Invernahavon Holiday Park and a residential property, Fernisdale, for domestic purposes.	Very High
ABS 9.3	Borehole	ch. 40,950	Consultation with THC and the landowner identified that Invertruim Cottage is supplied by a borehole for domestic purposes.	High
PW 9.15	Possible Well	ch. 42,050	A possible well or abstraction feature was observed during a site walkover (CFJV, November 2017) on the southern side of the existing A9 near Torra Dhaimh. However, the use and status of the feature has not been confirmed.	High

Feature Ref.	Feature Type	Chainage (ch.)	Description/ Consultation Details	Sensitivity
ABS 9.4	Spring	ch. 43,000	Consultation with THC and SEPA indicated Ralia Beag and Ptarmigan Cottage were supplied by two separate PWS. However, landowner consultation established both properties were formerly supplied by a single spring, located upgradient and adjacent south of the existing A9, with the supply network crossing the carriageway. The landowner confirmed both properties were connected to the mains approximately 7 to 8 years ago. A bung is understood to have been placed in the PWS pipe network to stop the water supply, but the network remains intact below the surface.	N/A
ABS 9.5	Spring	ch. 44,000	Consultation with THC and the landowner identified a PWS sourced from a spring, supplying the Spey Bridge Caravan Park and Cattle Farm for domestic and commercial (holiday let) purposes.	Very High
PW 9.1	Possible Well	ch. 44,100	Historical OS mapping indicated two possible well features near Ralia Lodge. Landowner consultation identified that, while the lodge and associated buildings had a PWS in the past, these were connected to the public mains approximately 7 to 8 years ago.	N/A
PW 9.2	Possible Well	ch. 44,300		N/A
PW 9.3	Possible Well	ch. 45,150	Historical OS mapping indicated a possible well near Braes of Nuide woodland, but landowner consultation and site walkovers (CFJV, November 2017) confirmed that there is no current PWS present or in use in this area.	N/A
ABS 9.6a	Borehole	ch. 45,700	Consultation with THC, the landowner and HighWater (Scotland) Ltd identified a PWS borehole (ABS 9.6a) at Nuide Farm, used to supply three residential buildings, a holiday let property and a cattle farm for domestic and agricultural purposes.	High
ABS 9.6b	Surface Water	ch. 45,600	The landowner also identified another supply (ABS 9.6b) sourced from surface water (Allt Eoghainn), which is used as a 'back-up' for ABS 9.6a and is due to be re-instated for agricultural use.	High
ABS 9.7	Surface Water	ch. 46,200	THC, landowner and HighWater (Scotland) Ltd information identified a PWS supplying properties at Milton of Nuide. The supply is sourced from Lochan Odhar some distance to the south of the existing A9 and the properties, and is used for domestic purposes.	High
PW 9.4	Possible Well	ch. 47,300	Historical OS mapping indicated a possible or historical well near Drumnanoich, but landowner consultation and site walkovers (CFJV, November 2017) confirmed that there is no current PWS present or in use in this area.	N/A
PW 9.5	Possible Well	ch. 47,550	Historical OS mapping indicated a possible or historical well near Blar Odhar woodland, but landowner consultation and site walkovers (CFJV, November 2017) confirmed that there is no current PWS present or in use in this area.	N/A
ABS 9.8a	Borehole	ch. 47,500	Consultation with THC, landowner and HighWater (Scotland) Ltd identified a PWS borehole (ABS 9.8a) supplying a residential property at Inverton for domestic purposes.	High
ABS 9.8b	Spring	ch. 47,500	Landowner consultation also identified an additional supply at Inverton, which is sourced from a spring (ABS 9.8b). This was formerly utilised as the supply to the residential property, but is now solely utilised for agricultural purposes.	High
ABS 9.9	Spring	ch. 49,100	Information received from THC identified a PWS sourced from a spring, supplying Knappach Cottage and Ruthven Cottage. Landowner consultation suggests the supply is sourced from an abstraction and is used for domestic purposes in both properties. The landowner also indicated that the supply was formerly used for agricultural purposes on the northern side of the A9 carriageway and part of the network crosses this.	High
ABS 9.10	Borehole	ch. 49,150	Consultation with THC, the landowner and HighWater (Scotland) Ltd identified a PWS borehole supplying five residential properties at Ruthven Farm for domestic purposes.	High

Feature Ref.	Feature Type	Chainage (ch.)	Description/ Consultation Details	Sensitivity
ABS 9.11	Borehole	ch. 49,250	Consultation with THC, landowner and HighWater (Scotland) Ltd identified a PWS borehole supplying three properties at Ruthven Steading for domestic purposes. The properties were previously linked to ABS 9.10 at Ruthven Farm.	High
PW 9.6	Possible Well	ch. 49,300	OS mapping indicated a possible or historical well near Ruthven Steadings, but landowner consultation and site walkovers (CFJV, November 2017) confirmed that there is no current PWS present or in use in this area.	N/A
PW 9.7	Possible Well	ch. 49,050	Historical OS mapping indicated a possible well near Ruthven Farm, but walkovers did not identify any evidence of PWS infrastructure in the locality. Discussions with a local resident suggested that the surrounding properties formerly shared a supply from in the vicinity of the PW 9.7 location, but these were now associated with others (ABS 9.9 and ABS 9.10).	N/A
ABS 9.12	Borehole	ch. 49,450	Information received from THC identified a PWS supplying a property at Gordonhall, sourced from surface water. Consultation with the landowner noted the supply present in THC records is now out of use, and the property is supplied by a borehole, with the water utilised for domestic purposes.	High
PW 9.8	Possible Well	ch. 50,300	Historical OS mapping indicated a possible or historical well at Stoneybrae near Kingussie. The landowner has been contacted regarding the status or use of the feature, but a response has not been received despite several attempts.	High
PW 9.9	Possible Well	ch. 50,550	Historical OS mapping indicated a possible well feature at Craig An Darach House, but landowner consultation indicated there is no current PWS present or in use in this area.	N/A
ABS 9.13	Surface Water	ch. 52,550	Information from THC identified a PWS supplying several properties in Balavil Estate, sourced from surface water. Consultation with the landowner confirmed the supply to be present and that this is gravity fed throughout the Estate for domestic and agricultural purposes. Landowner representatives also highlighted that the supply is linked to several properties on the southern side of the existing A9 – but that some of these are also connected to the mains in the area.	High
ABS 9.14	Surface Water	ch. 53,600	Information received from THC identified a PWS supplying a number of properties within Balavil Estate, sourced from surface water (Raitts Burn). Landowner consultation confirmed the properties believed to be linked to this supply are supplied by a separate source (ABS 9.13) and therefore, the supply is no longer active.	N/A
ABS 9.15	Spring/ Surface Water	ch. 54,200	Information received from THC and the landowner identified a PWS supplying Balavil House and a nearby mobile home for domestic purposes. The supply source is unconfirmed, but is believed to be located some distance north of the property and the landowner suggested that it is sourced from a spring or surface water.	High
PW 9.10	Possible Well	ch. 52,900	Historical and current OS mapping indicated two possible well features (PW 9.10 and PW 9.11) within and around Balavil Estate. Consultation with the landowner in relation to ABS 9.13, ABS 9.14 and ABS 9.15 located at Balavil did not confirm knowledge of these well features, but did initially identify the presence of three alternative well locations (PW 9.12 to PW 9.14). Additional discussions with representatives of the landowner and site walkovers with them (CFJV, August 2017) however, confirmed that there is no current PWS present or in use in the areas indicated.	N/A
PW 9.11	Possible Well	ch. 53,300		N/A
PW 9.12	Possible Well	ch. 53,200		N/A
PW 9.13	Possible Well	ch. 52,950		N/A
PW 9.14	Possible Well	ch. 54,150		N/A

Feature Ref.	Feature Type	Chainage (ch.)	Description/ Consultation Details	Sensitivity
ABS 9.16	Surface Water	ch. 56,050	Resident consultation during public exhibitions identified a PWS supplying Coulintyre Cottage. The supply is sourced from a surface water burn (unnamed) and used for domestic purposes. The supply network is believed to cross the existing A9 carriageway.	High
ABS 9.17	-	ch. 56,400	Information from THC indicated Farletter Cottage was supplied by a PWS, but subsequent resident consultation confirmed this property is now connected to the public mains.	N/A

10.3.57 The location of the PWS sources, supplied properties and possible well features are shown in **Drawings 10.23 to 10.34 (Volume 3)**, with those identified as abandoned or not active specifically highlighted. Some local natural spring and flush features identified from ecological surveys or current mapping are also shown, but these have not been identified as existing PWS sources.

Groundwater Dependent Terrestrial Ecosystems

10.3.58 As described in **Appendix 12.3 (Volume 2)**, NVC Surveys (MacArthur Green, 2015) identified several habitats in the study area that may be groundwater dependent; including wet woodland, wet grassland, fen, swamp and bog. The location and extents of these areas based on the groundwater dependence ratings in '*LUPS-GU31 Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and GWDTE (Version 3)*' (SEPA, 2017) are illustrated in **Drawings 10.23 to 10.34 (Volume 3)**.

10.3.59 The vegetation details of each potential GWDTE habitat area and an assessment of their likely dependence on groundwater is presented within **Appendix 10.2 (Volume 2)**. For the 225 habitats within the study area, this identifies that groundwater is unlikely to be a contributory source to 17 of them locally – particularly those comprising existing road verge, embankment or cut slopes, and where the wet vegetation is a fragmented or discontinuous part, associated with surface water features, drainage or run-off. A total of 40 habitats have also been assessed as being likely to have only a low dependence on groundwater due to their topographic setting, the likely influence of surface water and run-off or association with more ombrotrophic areas of peatland.

10.3.60 The hydrogeological conditions across the study area however, mean that groundwater inputs to the majority of habitat areas cannot be discounted and are indeed likely. Several areas identified as wet woodland (NVC W3, W4, W5, W6, W7), wet grassland (NVC MG9, MG10, MG11, CG10, M23), seepages, flushes or springs (NVC M5, M6, M10), fen (NVC M5, M27), swamp (NVC S11), wet heath (NVC M15), bog (NVC M6, M15, M25), or mosaics of these, have therefore been assessed as being likely to be dependent on groundwater to varying degrees. In this respect, 153 have been identified to have moderate dependence on groundwater, two have been identified to have moderate/ high dependence on groundwater, and 13 have been identified to have a high dependence on groundwater. These are located throughout the Proposed Scheme, where the topographic setting corresponds to potential or evidenced increased groundwater supply via emergence, seepage and through-flow from local issues or upwellings, soligenous or base-rich flushings, or the hydrogeological conditions are such that shallow water tables or groundwater inputs from permeable and productive superficial soils are likely to support GWDTE presence.

10.3.61 With reference to the ecological assessment in **Chapter 12**, it is also noted that the River Spey – Insh Marshes Ramsar, SPA and Insh Marshes SAC are of international importance and designated under the EU Habitats Directive for qualifying features including floodplain mire and loch habitats, transition mire and quaking bog, alder woodland on floodplains, nationally rare and scarce aquatic plants, and breeding bird populations that these and other habitat areas support. The River Spey – Insh Marshes SSSI is also of designated national importance for notified features

including floodplain fen, its assemblage of vascular plants, and similarly, other aspects that these support. The ecological assessment additionally notes that the Insh Marshes NNR is of national importance for nature conservation, public and community enjoyment, and that important species and habitats within it overlap with many of the notified features of the of the River Spey – Insh Marshes SSSI; including floodplain fen and the vascular plant assemblage.

- 10.3.62 It is therefore recognised that 57 of the GWDTE habitats in the study area partially or wholly fall within the River Spey – Insh Marshes Ramsar, SSSI and Insh Marshes SAC boundaries, and 51 partially or wholly fall within the Insh Marshes NNR boundaries. Of these, three areas of wet woodland and one area of bog correspond to the alder woodland and transition mire and quaking bog qualifying interests of the Insh Marshes SAC. Forty-two areas of swamp, fen, wet woodland, wet grassland, bog or mosaics of these also correspond to or contain components of either the floodplain fen, mire or plant assemblage interests of the River Spey – Insh Marshes Ramsar, SSSI and Insh Marshes NNR.
- 10.3.63 Based on the criteria in **Table 10-4**, the sensitivity of the individual GWDTE identified in the study area are presented in **Appendix 10.2 (Volume 2)**. These are considered to vary between **medium** and **very high** sensitivity based on their likely groundwater dependence. Those determined to have no dependence on groundwater input are considered **low** sensitivity and are assessed further as part of the ecological impact assessment in **Chapter 12**.

Surface Water Features

- 10.3.64 All surface water features within the study area are described within **Chapter 11** and shown in **Drawings 11.1 to 11.12 (Volume 3)**. These are expected to have a groundwater baseflow component, and groundwater may be a contributor to local flooding mechanisms.
- 10.3.65 The principal surface watercourses are the River Truim and the River Spey. The River Truim flows northward to the west of the A9 carriageway in the south of the study area, towards confluence with the River Spey approximately 750m to the west (ch. 41,400). The River Spey then descends northward to the west of the A9 from Newtonmore, crossing to the eastern side of the A9 carriageway near Kingussie (ch. 50,200) and crossing Loch Insh on the outskirts of and through Kincaig to the north. Both the River Truim and River Spey form part of the River Spey SAC, which is designated for the protection of freshwater pearl mussel, sea lamprey, Atlantic salmon and otter. The River Spey also forms part of the River Spey – Insh Marshes Ramsar, SPA, SSSI and the Insh Marshes SAC and NNR.
- 10.3.66 Other surface watercourses in the study area include the Burn of Inverton, Raitts Burn, Allt Eoghainn, Allt Cealgach and several additional watercourse tributaries, predominantly to the River Spey, which cross under the Proposed Scheme. Based on **Table 10-4** and corresponding sensitivity criteria in **Chapter 11** and **Chapter 12**, surface watercourse features within the study area are considered to vary between **low** and **very high** sensitivity.
- 10.3.67 Samples were retrieved following the Preliminary GI at 11 surface water locations – including the River Spey, Allt Torr Daimh, Caochan Riabhach, Allt Eoghainn, the Milton Burn and others across the Proposed Scheme. The results of subsequent chemical testing have been compared against water quality standards for drinking water and surface water. This identified low-level PAH detections in the majority of samples, with some of these and concentrations of chloride observed to exceed the drinking water and/ or surface water standards at Caochan Riabhach (ch. 43,800) and an unnamed watercourse near the proposed Kingussie junction (ch. 50,800).

Potential Contamination

- 10.3.68 Ninety principal potential contamination sources have been identified in the study area as part of the assessment, together with 116 individual occurrences of made ground or visual/ olfactory indications of contamination. Details of these are provided in **Appendix 10.4 (Volume 2)** and each has been assigned a reference (prefixed 'CK'), to assist identification and assessment. The locations of each potential source are shown in **Drawings 10.35 to 10.46 (Volume 3)**.
- 10.3.69 Available soil sample chemical testing results have been compared against published generic assessment criteria for residential, commercial and open space land uses (DEFRA, 2014; LQM/ CIEH, 2015) to assess potential risks to construction/ maintenance workers, transient end users and local residents during construction. Potential exposure pathways to end users and local residents during operation are likely to be limited, but may remain valid along access tracks and for maintenance workers during inspection or repair activities.
- 10.3.70 The samples analysed from within the permanent and temporary works boundaries of the Proposed Scheme did not identify any soil contaminant concentrations in excess of the published criteria. However, several individual concentrations of lead have been identified to exceed the open space standards at depths between ground level and 1.00m within and around a target mound associated with a former rifle range at the Dellmore of Kingussie (CK-58). This is located outwith the permanent and temporary works boundaries of the Proposed Scheme, but is discussed further in **Appendix 6.2 (Volume 2)**.
- 10.3.71 Ground gas data has been collected from 18 borehole locations on up to 12 occasions between January and December 2016 for the Advanced GI, and on up to six occasions from 95 borehole locations between January and June 2018 for the Preliminary GI. As ground gases may pose risks to humans working below ground or in confined spaces during construction, concentrations were compared to published assessment criteria (HSE, 2011; CIRIA, 2007; BS 8485, 2015) for elevated methane, carbon dioxide, depleted oxygen, carbon monoxide, hydrogen sulphide and volatile organic compounds (VOCs).
- 10.3.72 Detections of methane (between 1 and 81% volume/ volume (v/v)) have been recorded in 65 monitoring locations, with the concentrations observed to exceed the safety threshold of 1% v/v on one or more occasion. None of the locations are observed to be associated with any particular source area or made ground. However, each of the installations are screened in or across glaciofluvial or alluvial materials and locally, peat; suggesting these may be the potential source.
- 10.3.73 Carbon dioxide concentrations exceed the short term occupational exposure limit (1.5% v/v) in 52 boreholes and the long-term exposure limit (0.5% v/v) in 85 boreholes on one or more occasion across the Proposed Scheme, with detected concentrations ranging between 0.1 and 20.8% v/v. Depleted oxygen concentrations below 19% v/v have also been observed in 30 boreholes on one or more occasion, with levels considered to be very low (less than 16% v/v) in 11 instances, frequently coinciding with the detected methane and carbon dioxide levels.
- 10.3.74 Some boreholes recorded isolated detections of carbon monoxide between 1 and 27 parts per million (ppm), which are below the short and long-term exposure limits for this gas. However, two borehole locations detected concentrations in excess of the short term exposure limit (30 ppm) – one on two occasions at concentrations of 78 and 101 ppm and the other on three occasions, once at a concentration of 66 ppm and twice at a concentration of 42 ppm.
- 10.3.75 Detections of hydrogen sulphide were recorded in one borehole location at 40 ppm on one occasion, exceeding the short (10 ppm) and long-term (5 ppm) exposure limits. VOC concentrations were also observed to slightly exceed the long-term exposure limit for benzene (1

ppm) in two locations on one occasion – one at a concentration of 1.6 ppm and the other at a concentration of 4.1 ppm.

10.4 Potential Impacts

Embedded Mitigation

10.4.1 Throughout the DMRB Stage 3 design development process described in **Chapter 4**; a number of environmentally-led workshops considered each aspect of the developing design and made recommendations for certain features or aspects of the design to be reconsidered. These aspects have been defined as ‘embedded mitigation’.

10.4.2 With respect to geology, soils and groundwater, the approach to achieving a first-level of embedded mitigation for the Proposed Scheme, was to avoid, reduce, minimise or account for potential impacts on receptors as far as practicable. This was achieved through the following:

- layout and positioning of Proposed Scheme infrastructure or auxiliary elements, to avoid, reduce or minimise disturbance of soils of conservation value, deep peat and GWDTE
- where avoidance has not been possible, local level assessments were completed where possible, to determine local solutions such as earthworks extent reductions to reduce or minimise impacts or inform management plans for storage, re-instatement and re-use
- layout and positioning of infrastructure to avoid, reduce or minimise disturbance of features of geodiversity interest
- watercourse diversions, culverts and drainage to re-direct and maintain hydrological regimes across the Proposed Scheme as far as practicable.

Potential Impact Assessment

10.4.3 When assessing potential impacts from the Proposed Scheme, construction and operation phases have been considered together, as the majority of construction impacts (such as removal of excavated material) will be permanent and extend through operation. Where differences are predicted between construction and operation, these have been assessed for each phase in turn.

10.4.4 There are several ways that the Proposed Scheme may impact on geology, soils or groundwater features during construction and operation. These include:

- excavation or masking of bedrock or superficial deposit exposures or sites of specific scientific or geodiversity interest, particularly if the features are not reproduced elsewhere in the area
- constraint or limitation to existing or potential commercial exploitation of mineral resources
- excavation, removal or sealing of local soil resources, such as soils of conservation interest or potentially productive agricultural soils
- excavation or removal of peat, with resultant carbon release and potential permanent loss, unless environmentally beneficial re-use or restoration can be achieved
- impacts on groundwater during construction and operation, through dewatering or aspects of infrastructure which may impede or alter local hydrological regimes and groundwater flows
- spillage or leakage of fuels or oils from storage tanks or construction plant which, without suitable mitigation measures, can enter aquifers and subsequently migrate

- groundwater change may impact peat, GWDTE, surface water, abstractions or PWS; GWDTE are also susceptible to direct loss and drawdown via dewatering
- during operation, surface run-off may contain elevated pollutant concentrations such as oils, suspended solids, metals, salt and anti-freeze agents, leading to pollution of groundwater.

10.4.5 A key aspect of the impact assessment has been to identify areas of excavation for the Proposed Scheme, as shown in **Drawings 10.23 to 10.46 (Volume 3)** and summarised in **Table 10-13**. Only excavations equal to or greater than 1.00m depth are identified, and widening of existing cuttings have been labelled as ‘widening’ and new cuttings labelled as ‘cutting’.

Table 10-13: Excavation Areas and Depths (equal to or greater than 1.00m)

Earthwork Ref. ¹	Cutting/Widening	Chainage (approx.)	Maximum Excavation Depth (m bgl)	Local Groundwater Depth Range (m bgl)	Local Bedrock Depth Range (m bgl)	Likelihood to Intercept Groundwater ²	Likelihood to Intercept Bedrock ²
Mainline							
P9-MC-01	Widening	ch. 40,700 to ch. 41,150	13.29	0.70 to 19.85	>25.00 ⁵	Likely	Low
P9-MC-02	Widening	ch. 41,475 to ch. 41,525	5.20	Dry	>15.00 ⁵	Low	Low
P9-MC-03	Widening	ch. 42,750 to ch. 42,025	8.01	19.80 to 21.60	>10.00 ⁵	Low	Low
P9-MC-04	Widening	ch. 42,325 to ch. 42,425	6.28	0.02 to 12.48	13.30	Likely	Low
P9-MC-05	Widening	ch. 42,980 to ch. 43,200	4.16	2.00 to 4.56	7.00	Likely	Low
P9-MC-06	Cutting	ch. 43,600 to ch. 44,025	13.70	0.44 to 8.10	GL to 4.00	Likely	Likely
P9-MC-07	Cutting	ch. 44,425 to ch. 45,625	12.62	0.97 to 12.24	GL to 18.00	Likely	Likely
P9-MC-08 ²	Cutting	ch. 44,800 to ch. 45,450	3.29	6.00	>10.00 ⁵	Low	Low
P9-MC-09 ²	Widening	ch. 45,675 to ch. 45,725	2.76	Dry	>10.00 ⁵	Low	Low
P9-MC-10 ²	Widening	ch. 46,225 to ch. 46,375	1.08	1.20 to 3.13	>10.00 ⁵	Low	Low
P9-MC-11	Widening	ch. 46,475 to ch. 46,875	7.22	6.92 to 11.30	>10.00 ⁵	Likely	Low
P9-MC-12	Widening	ch. 47,375 to ch. 47,725	7.62	Dry	>18.00 ⁵	Low	Low
P9-MC-13	Widening	ch. 48,150 to ch. 48,650	9.34	6.82 to 9.42	>15.00 ⁵	Likely	Low
P9-MC-14	Widening	ch. 49,150 to ch. 49,200	4.86	Dry	31.80	Low	Low
P9-MC-15	Cutting	ch. 50,225 to ch. 50,375	1.71	5.79 to 11.43	47.90 to 54.00	Low	Low
P9-MC-16	Cutting	ch. 50,950 to ch. 51,025	2.96	Dry	>10.00 ⁵	Low	Low
P9-MC-17	Cutting	ch. 51,500 to ch. 51,625	3.47	Dry	>4.00 ⁵	Low	Low
P9-MC-18 ²	Cutting	ch. 51,600 to ch. 51,625	1.51	1.99 to 3.00	4.00 to 5.80	Low	Low
P9-MC-19	Widening	ch. 52,025 to ch. 52,650	7.67	2.56 to 15.50	14.80 to 18.45	Likely	Low
P9-MC-20	Widening	ch. 53,050 to ch. 53,225	4.80	Dry	>10.00 ⁵	Low	Low
P9-MC-21	Widening	ch. 53,800 to ch. 53,925	2.85	0.33 to 4.20	12.70	Likely	Low
P9-MC-22	Widening	ch. 54,300 to ch. 56,000	7.15	0.33 to 8.50	5.70 to 8.50	Likely	Likely
P9-MC-23	Widening	ch. 55,700 to ch. 55,840	1.45	Dry	>12.50 ⁵	Low	Low
P9-MC-24	Widening	ch. 56,075 to ch. 56,125	6.92	Dry	>10.00 ⁵	Low	Low
P9-MC-25 ²	Widening	ch. 56,220 to ch. 56,480	11.52	6.35 to 9.84	>23.00 ⁵	Likely	Low
P9-MC-26 ²	Widening	ch. 56,275 to ch. 56,450	2.69	2.36 to 6.50	>15.00 ⁵	Likely	Low
P9-MC-27	Widening	ch. 56,525 to ch. 56,600	6.90	Dry	>15.00 ⁵	Low	Low
Junctions							
P9-NJ-01	Cutting	ch. 43,350 to ch. 43,425	7.82	7.99 to 8.33	18.00	Low	Low
P9-NJ-02	Cutting	ch. 43,350	7.08	GL to 4.99	9.50	Likely	Low
P9-NJ-03 ²	Cutting	ch 43,450	1.53	4.70 to 8.00	>4.10 ⁵	Low	Low
P9-KJ-01	Cutting	ch. 50,900 to ch. 51,050	4.87	Dry	>10.00 ⁵	Low	Low
Side Roads and Access Tracks							
P9-GT-01	Cutting	ch. 40,700 to ch. 40,875	2.31	Dry	>6.00 ⁵	Low	Low
P9-GT-02	Cutting	ch. 40,925 to ch. 41,125	4.00	Dry	>4.00 ⁵	Low	Low

Earthwork Ref. ¹	Cutting/Widening	Chainage (approx.)	Maximum Excavation Depth (m bgl)	Local Groundwater Depth Range (m bgl)	Local Bedrock Depth Range (m bgl)	Likelihood to Intercept Groundwater ²	Likelihood to Intercept Bedrock ²
P9-GT-03 ²	Cutting	ch. 41,250 to ch. 41,375	1.13	Dry	>4.50 ⁵	Low	Low
P9-GT-04	Cutting	ch. 41,950 to ch. 42,500	1.70	Dry	>4.00 ⁵	Low	Low
P9-NF-01 ²	Cutting	ch. 45,425 to ch. 45,575	2.09	14.02 to 14.35	18.00	Low	Low
P9-NF-02 ²	Cutting	ch. 45,800 to ch. 45,900	4.22	Dry	>3.00 ⁵	Low	Low
P9-NF-03 ²	Cutting	ch. 45,950 to ch. 46,000	3.39	Dry	>4.00 ⁵	Low	Low
P9-NF-04	Cutting	ch. 46,050	2.08	5.33 to 15.20	19.80	Low	Low
P9-NF-05 ²	Cutting	ch. 46,050 to ch. 46,150	5.41	Dry	>4.00 ⁵	Low	Low
P9-NF-06 ²	Cutting	ch. 46,200 to ch. 46,250	2.76	Dry	>3.70 ⁵	Low	Low
P9-NF-07 ²	Cutting	ch. 46,250 to ch. 46,350	1.86	1.90 to 3.13	>10.00 ⁵	Low	Low
P9-NF-08	Cutting	ch. 46,300 to ch. 46,375	2.40	Dry	>3.70 ⁵	Low	Low
P9-NF-09 ²	Cutting	ch. 46,425 to ch. 46,525	2.72	6.92 to 11.30	>10.00 ⁵	Low	Low
P9-NF-10 ²	Cutting	ch. 46,100	5.38	5.53 to 15.20	19.80	Low	Low
P9-NF-11	Cutting	ch. 46,600 to ch. 46,900	2.59	6.92 to 11.30	>10.00 ⁵	Low	Low
P9-NF-12 ²	Cutting	ch. 46,950 to ch. 47,150	4.18	Dry	>10.00 ⁵	Low	Low
P9-KN-01	Cutting	ch. 48,800	2.59	9.71 to 9.73	22.50	Low	Low
P9-KN-02 ²	Cutting	ch. 48,700	3.06	Dry	>10.00 ⁵	Low	Low
P9-KN-03	Widening	ch. 48,400 to ch. 48,575	4.88	9.79 to 9.84	11.50	Low	Low
P9-CS-01	Cutting	ch. 50,225 to ch. 50,325	6.85	5.79 to 11.43	47.90 to 54.00	Likely	Low
P9-CS-02	Cutting	ch. 50,225 to ch. 50,350	5.52	5.79 to 11.43	47.90 to 54.00	Low	Low
P9-CC-01 ²	Cutting	ch. 55,300 to ch. 55,500	4.78	1.20 to 9.00	>15.00 ⁵	Likely	Low
P9-BL-01 ²	Cutting	ch. 52,225 to ch. 52,350	1.75	2.56 to 9.32	>10.00 ⁵	Low	Low
P9-BL-02	Cutting	ch. 52,650 to ch. 52,750	2.63	Dry	>3.00 ⁵	Low	Low
P9-BL-03	Cutting	ch. 52,775 to ch. 52,825	4.54	0.90	>3.00 ⁵	Likely	Low
P9-BL-04	Cutting	ch. 52,900 to ch. 53,200	4.98	Dry	>10.00 ⁵	Low	Low
Sustainable Drainage System (SuDS) Basins							
SuDS 417	Cutting	ch. 41,700	1.00	3.16 to 4.10	>10.00 ⁵	Low	Low
SuDS 434	Cutting	ch. 43,400	3.50	4.70 to 8.00	>10.00 ⁵	Low	Low
SuDS 458	Cutting	ch. 45,800	2.60	Dry	>3.00 ⁵	Low	Low
SuDS 461	Cutting	ch. 46,100	6.62	5.33 to 15.20	19.80	Likely	Low
SuDS 474 ²	Cutting	ch. 47,500	2.60	3.20	>3.40 ⁵	Low	Low
SuDS 487	Cutting	ch. 48,700	3.00	4.45 to 9.73	22.50	Low	Low
SuDS 490	Cutting	ch. 49,000	3.60	Dry	>4.50 ⁵	Low	Low
SuDS 493 ²	Cutting	ch. 49,300	1.40	0.90 to 3.05	34.50 to 44.00	Likely	Low
SuDS 507	Cutting	ch. 50,700	2.35	0.91 to 1.35	>20.00 ⁵	Likely	Low
SuDS 509 ²	Cutting	ch. 50,900	3.00 to 10.00 ³	Dry	>20.00 ⁵	Low	Low
SuDS 513	Cutting	ch. 51,300	4.50	3.09 to 8.22	>10.00 ⁵	Likely	Low
SuDS 530	Cutting	ch. 53,000	5.30	0.58 to 2.50	>10.00 ⁵	Likely	Low
SuDS 534	Cutting	ch. 53,400	2.10	0.37 to 1.70	>10.00 ⁵	Likely	Low
SuDS 537	Cutting	ch. 53,700	3.10	1.14 to 1.85	>10.00 ⁵	Likely	Low
SuDS 561 ²	Cutting	ch. 56,100	7.00	2.36 to 6.50	>15.00 ⁵	Likely	Low
SuDS 563 ²	Cutting	ch. 56,300	2.50	2.36 to 6.50	>15.00 ⁵	Likely	Low
Compensatory Flood Storage Areas (CSA)⁴							
CSA 1	Cutting	ch. 46,000	1.50	Dry	>4.00 ⁵	Low	Low
CSA 2	Cutting	ch. 45,900	1.50	5.33 to 15.20	19.80	Low	Low
CSA 7	Cutting	ch. 50,700	1.50	0.91 to 1.35	>20.00 ⁵	Likely	Low
CSA 9	Cutting	ch. 53,100	1.50	0.58 to 2.50	>10.00 ⁵	Likely	Low
CSA 10	Cutting	ch. 53,400	1.50	2.50	>10.00 ⁵	Low	Low

Earthwork Ref. ¹	Cutting/Widening	Chainage (approx.)	Maximum Excavation Depth (m bgl)	Local Groundwater Depth Range (m bgl)	Local Bedrock Depth Range (m bgl)	Likelihood to Intercept Groundwater ²	Likelihood to Intercept Bedrock ²
CSA 11	Cutting	ch. 55,200	1.50	3.98 to 5.25	>10.00 ⁵	Low	Low

Table Notes:

1. Earthworks references and proposed SuDS basins/ compensatory flood storage areas are shown on **Drawings 10.23 to 10.46 (Volume 3)**
2. Groundwater level information based on water strike data or nearby locations
3. Existing topography is variable at proposed SuDS basin 509, resulting in the noted potential excavation depth range
4. Each flood storage area will be subject to detailed design, may be terraced in nature, depths of excavation will vary and some will involve both excavation and displacement. The assessment has been based on these typically involving excavation through removal of soils/ peat turves to a maximum depth of 0.50m and removal of a further 1.00m of material, prior to re-instatement of the soils/ peat turves to create an area 1.00m lower than existing ground level
5. Bedrock level not proven, depth range based on observed superficial thicknesses within or nearby the footprint

10.4.6 Cuttings for the mainline of the Proposed Scheme predominantly relate to widening of existing cuts on sloping ground; which is likely to have lesser effects on baseline groundwater conditions. However, some areas of the mainline at Newtonmore and Kingussie will require new cuttings, together with SuDS basins, attenuation tanks, side roads and access tracks, compensatory flood storage areas and the proposed Newtonmore and Kingussie junctions.

10.4.7 The mainline is also proposed offline to the south/ east of the existing carriageway between ch. 49,200 and ch. 51,600 near the Insh Marshes. Although this is proposed on embankment, works for the offline section will comprise removal of the existing A9 carriageway and embankments, crossing of the River Spey (demolition and replacement of the existing bridge structure, including piling) and excavation below the new embankments for the removal of silt, peat or soft material. Retaining walls, filter drains associated with SuDS basin networks, pre-earthworks drainage, culverts (extension or replacement), changes to existing structures (demolition and replacement or extension) and other new structures are also proposed throughout the Proposed Scheme.

Geology

Superficial Geology

10.4.8 Made ground, fluvial and glacial superficial deposits of **negligible** sensitivity (alluvium, river terrace deposits, alluvial fan deposits, glaciofluvial deposits, glaciolacustrine, till and hummocky glacial deposits) within the permanent and temporary works boundaries of the Proposed Scheme are likely to be impacted by construction of all widenings, cuttings, side roads and access tracks, SuDS basins, drainage, structures, culverts, compensatory flood storage areas and watercourse diversions, to varying extents.

10.4.9 The reduction in extent of these deposits as a result of the construction activities is considered to be of **minor** magnitude because of their widespread occurrence in the region and the country, and therefore minimal percentage loss. There is also the potential for these deposits to be re-used within the Proposed Scheme. As a result, the overall impact significance is considered to be **Neutral** for both the construction and operation phases.

Solid Geology

10.4.10 Bedrock of **negligible** sensitivity is considered likely to be intercepted by mainline widening P9-MC-22 and cuttings P9-MC-06 and P9-MC-07, as identified in **Table 10-13**. Due to the widespread occurrence of the rock types in the region and country, these are expected to represent a **minor** magnitude of impact on the solid geology, resulting in an impact significance of **Neutral** during construction and operation.

- 10.4.11 The use of blasting in areas of rock cut may also be required, which may impact upon the existing rock structure and have the potential to generate new fractures, extend existing ones and have indirect impacts on groundwater flow paths. The impacts of blasting on such flow paths have been considered in the groundwater assessment. However, based on the anticipated depth of rock cut at the locations identified in **Table 10-13** and the structural geology present (including faulting), the impacts of blasting on the solid geology are expected to be of **minor** magnitude and **Neutral** significance during construction and operation.

Designated Geological Receptors and Features of Geodiversity Interest

Lochan an Tairbh

- 10.4.12 Lochan an Tairbh is of **medium** sensitivity, exhibiting a classic example of intact kame and kettle terrain, and represents one of the best examples of this anywhere in Britain (Transport Scotland, 2014a). As shown in **Drawing 10.10 (Volume 3)**, pre-earthworks drainage and two watercourse diversions are proposed in the immediate vicinity of the lochan – one for an existing drainage ditch (W9.57) and another for an existing unnamed minor tributary (W9.15) to it. The permanent works boundaries also extend toward and partially encroach the lochan, encompassing areas of land already owned by the Scottish Government from the original A9 carriageway construction.
- 10.4.13 No indirect dewatering effects are anticipated from the nearest widenings or cuttings, and the proposed drainage and watercourse diversions are relatively small scale in terms of excavation and earthworks. The importance of the intact landform and value of the area is therefore considered unlikely to be significantly affected as result of these. However, disturbance may occur within the permanent works boundaries, while water quality within the lochan and sediments potentially preserved in it could be vulnerable to direct impact and loss, and from unnatural run-off, water, sediment discharge or contamination as a result of spillage incidents. Based on the criteria in **Table 10-2**, these potential impacts are assessed to be of **moderate** magnitude and **Moderate** significance during construction and operation.

Rock Exposures

- 10.4.14 Based on **Table 10-13**, mainline cuttings P9-MC-06 and P9-MC-07 are likely to intercept bedrock and the entirety of existing rock exposure areas P09-RE01 (psammite, locally schistose with quartz veins) and P09-RE02 (psammite with quartz veins), which are of **negligible** sensitivity. These cuttings are likely to have a **major** magnitude of impact, relative to the proportion of rock exposure loss defined in **Table 10-2**, resulting in impacts of **Slight** significance during construction and operation.

Mineral Extraction

- 10.4.15 There is historical and current evidence of local rock, sand and gravel deposit extraction within the study area, and potential future exploitation of similar resources cannot be discounted. Due to the relatively widespread occurrence of these deposits (**low** sensitivity) in the region, the magnitude of potential impact from the Proposed Scheme is considered to be **minor** based on the minimal percentage loss of local resource and the criteria in **Table 10-2**, resulting in an impact of **Neutral/ Slight** significance during construction and operation. No potential impacts in relation to current or ongoing rock extraction activities at Meadowside Quarry are anticipated.

Soils

Soil Conservation

- 10.4.16 Soils of **medium** conservation interest (humus-iron podzols and mineral alluvial soils) are likely to be impacted by the construction of widenings, cuttings, side roads and access tracks, SuDS basins, drainage, structures, culverts, compensatory flood storage areas and watercourse diversions throughout the Proposed Scheme extents.
- 10.4.17 The impact on the conservation interest of the soils as a result of the construction activities is considered to be of **minor** magnitude. This equates to partial losses and soil disturbance across the Proposed Scheme, but where their overall rarity, representivity and diversity is unlikely to be significantly diminished and conservation value in the region will not be significantly affected. There is also the potential for soils to be re-used within the Proposed Scheme or re-instated. The impact significance in terms of soil conservation interest is therefore considered to be **Slight/ Moderate** for both construction and operation.

Agricultural Soil Productivity

- 10.4.18 Potential impacts in relation to agricultural land use and viability interests on land owned by the RSPB, Church of Scotland, the Phoinies, Ralia, Balavil and Dunachton Estates and holdings at Ruthven and Laggan are assessed in **Chapter 8**. Based on this assessment, an approximate and combined 117.11 hectares of agricultural land area and **low to medium** sensitivity soil in terms of agricultural productivity, may be disturbed through construction of the Proposed Scheme.
- 10.4.19 Due to the wider distribution of the soils and their respective LCA Classes in the study area, this is considered to represent an impact of **minor** magnitude in terms of agricultural soil productivity. There is also the potential for soils to be re-used as part of the Proposed Scheme or re-instated. Potential impacts are therefore assessed to be of **Neutral/ Slight to Slight/ Moderate** significance during both construction and operation.

Peat

- 10.4.20 The Proposed Scheme has been designed at this stage to avoid, reduce or minimise disturbance and impact in areas of peat and reduce potential excavation volumes, as detailed in the Outline Peat Management Plan (OPMP) within **Appendix 10.6 (Volume 2)**. However, some areas have proven to be unavoidable and will be disturbed during the construction of several widenings, cuttings, embankments, side roads and access tracks, SuDS basins, drainage, structures, culverts, watercourse diversions and compensatory flood storage areas.
- 10.4.21 Based on the dimensions and anticipated design nature for each of these Proposed Scheme elements, and utilising the peat depth model shown in **Drawings 10.11 to 10.22 (Volume 3)**; the volumes of peaty soil/ topsoil, shallow peat and deep peat (including separation as acrotelm and catotelm) estimated to be excavated during construction are summarised in **Table 10-14**.

Table 10-14: Estimated Peaty Soil/ Topsoil and Peat Volumes to be Excavated

Scheme Element	Estimated Excavation Volume ¹ (m ³)			Estimated Acrotelm-Catotelm Excavation Volume ² (m ³)	
	Peaty Soil/ Topsoil	Shallow Peat	Deep Peat	Acrotelm	Catotelm ³
Side roads and access tracks	18,644	1,591	431	384	1,638
River Spey Bridge Pier Footings	42	0	0	0	0
Drainage	9,937	2,108	633	987	1,754

Scheme Element	Estimated Excavation Volume ¹ (m ³)			Estimated Acrotelm-Catotelm Excavation Volume ² (m ³)	
Mainline and junctions (excluding Newtonmore junction)	79,501	11,417	4,409	2,998	12,827
Newtonmore junction	2,328	1,338	1,984	510	2,812
Permanent SuDS Basins	8,913	1,966	0	480	1,486
Compensatory Flood Storage Areas	0	142	55	92	105
Watercourse Diversions	1,934	847	59	285	621
Totals	121,299	19,409	7,571	5,736	21,243

Table Notes:

1. Estimated volumes are residual (i.e. net excavation volumes after any re-instatement at the point of excavation has been accounted for) and in all instances, the volumes have been updated to account for the areas not yet covered by the peat depth model, as further detailed in **Appendix 10.6 (Volume 2)**.
2. Acrotelm and catotelm are defined in **Appendix 10.1 (Volume 2)** and quantities are based upon the measured thickness of acrotelm in the field in shallow and deep peat as described in **Appendix 10.6 (Volume 2)**. If the top 0.50m were to be treated as acrotelm (as suggested in **Appendix 10.6 (Volume 2)**), the volume estimated for this would increase and that for catotelm would decrease.
3. Based on data presented in **Appendix 10.1 (Volume 2)**, evidence of strongly decomposed peat has been observed in selected areas based on von Post (Hobbs, 1986) classifications. Of the calculated residual catotelm quantities, approximately 10% (equivalent to **2,124m³**) may be strongly decomposed (H7 or greater) and for which re-use options may be more limited than less decomposed peat.

- 10.4.22 No areas of priority peatland will be impacted by the Proposed Scheme. However, the estimated excavation volumes correspond to the permanent and temporary disturbance of natural, semi-natural or successional peat based habitats such as blanket bog, wet heath, mosaics of these and other mires, fen, marsh, swamp, dry heath and grassland, as described in **Chapter 12**.
- 10.4.23 Based on these considerations and the criteria in **Table 10-2**, the magnitude of direct disturbance impacts from the Proposed Scheme in relation to peaty soil, topsoil and peat are anticipated to be **minor** to **moderate** overall. This equates to partial disturbance or loss of individual areas of varying sensitivity throughout, but predominantly where it is considered their value would either not be affected, or would be, but not to a major degree. The key areas of potential impact are located within and adjacent to the Proposed Scheme at Newtonmore (ch. 42,700 to ch. 43,600), Nuide (ch. 46,000) and south of the existing A9 near Drumnanoich (ch. 46,700 to ch. 47,300) and Lynchat (ch. 52,000); where the proposed infrastructure intercept or border areas of shallow and deep peat in blanket bog, wet heath or other mire habitats. Areas of fen, marsh, swamp and wet woodland containing pockets of shallow and deep peat are also partially encroached in northern extents between the B9152 and Highland Mainline railway (ch. 54,100, ch. 55,500 and ch. 56,400). Based on this and the estimated excavation volumes; direct impacts are therefore anticipated to be of **Neutral** to **Slight/ Moderate** significance for the majority of the Proposed Scheme and of **Moderate** significance in the areas noted, during construction and operation.
- 10.4.24 Areas of excavation within and adjacent to peat may also lead to its oxidation via dewatering, while other infrastructure may impede or alter local hydrological regimes. Based on estimates of potential dewatering extents (JNCC, 2005; CIRIA, 2016), typical peat permeabilities (Stewart and Lance, 1991; Nayak *et al.*, 2008; Dargie, 2009; Scottish Government, 2011c) and consideration of where such effects may occur; the magnitude of potential indirect impacts on areas of peat are anticipated to be predominantly **minor**, resulting in impacts of **Neutral** to **Slight/ Moderate** significance for the majority of the Proposed Scheme, and up to **Moderate** significance in the areas previously noted at Newtonmore, Nuide, Drumnanoich, Lynchat and northern extents.
- 10.4.25 A Preliminary Peat Landslide Risk Assessment for the Proposed Scheme has identified risks across the majority of it and adjacent areas to be negligible or slight. However, areas assessed to be of

moderate and locally, substantial risk, have also been highlighted. The location of these are detailed in **Appendix 10.5 (Volume 2)** and illustrated in **Drawings 10.5.15 to 10.5.20 (Volume 3)**.

Groundwater

10.4.26 Potential impacts on groundwater levels and flow are outlined below, followed by consideration of impacts that may apply to groundwater quality, PWS, GWDTE and surface water features.

Groundwater Levels and Flow

10.4.27 Several areas of mainline widening or other cutting have the potential to intercept groundwater, as identified in **Table 10-13**. This is expected to result in lowering of groundwater levels and alter local flow directions in these areas. The excavations are anticipated to be formed in granular till and hummocky glacial deposits (**medium** sensitivity), but also glaciofluvial, alluvium and alluvial fan deposits (**high** sensitivity) throughout the Proposed Scheme.

10.4.28 Due to the nature of the existing topography and that the majority of mainline cuttings relate to widening of existing ones, the impacts on groundwater levels and flows in superficial deposits are assessed to be of predominantly **minor** magnitude. This equates to impacts of **Slight** significance on till and hummocky glacial deposits and **Slight/ Moderate** significance on glaciofluvial, alluvium and alluvial fan deposits during construction and operation. The magnitude of potential impacts may be higher within and adjacent to certain widenings and cuttings (P9-MC-01, P9-MC-06, P9-MC-07, P9-MC-19, P9-MC-22 and P9-MC-25) and the proposed Newtonmore junction (P9-NJ-02), due to the depth of excavation, potential drawdown and/ or likelihood for local flow patterns to be altered. Potential groundwater level and flow impacts on superficial deposits in these areas are assessed to be of **Moderate** magnitude and **Moderate to Moderate/ Large** significance.

10.4.29 Bedrock groundwater may be locally intercepted in some areas of widening or cutting underlain by the Loch Laggan Psammite Formation (**medium** sensitivity), while the requirement for rock blasting cannot be ruled out. Based on the location of the areas, the structural geology present (including faulting), depth of possible rock cut and the criteria in **Table 10-5**, potential impacts on bedrock groundwater levels and flows are considered to be of **minor** magnitude and **Slight** significance during construction and operation.

10.4.30 The construction of embankments across the Proposed Scheme may also result in excavation or compaction of shallow soil and superficial deposits below their footprint, while pre-earthworks drainage during construction, and filter drains during operation, could create localised drawdown or mounding of shallow groundwater. Demolition and replacement of the existing River Spey bridge additionally has the potential to alter local groundwater levels and flows at shallow and greater depth, due to piled foundations for the proposed bridge pier footings, removal of the existing ones and removal of the existing A9 carriageway and embankments. These aspects are assessed to result in localised impacts of **minor** magnitude and **Slight to Slight/ Moderate** significance on groundwater levels and flows across the Proposed Scheme.

Groundwater Quality

10.4.31 Based on groundwater vulnerability mapping shown in **Drawing 10.9 (Volume 3)**, all groundwater within the study area is vulnerable to accidental spillages, uncontrolled run-off and increased sedimentation during construction or operation, unless appropriate measures for the control of discharge, run-off and drainage are undertaken. The areas at highest risk are those in the vicinity of widenings and cuttings anticipated to intercept groundwater in **Table 10-13**. The magnitude of potential impacts is assessed as **moderate** on superficial deposits (**medium to high** sensitivity), bedrock (**medium** sensitivity) and associated receptors such as GWDTE (**medium to very high** sensitivity), resulting in groundwater quality impacts of **Moderate to Very Large** significance.

- 10.4.32 SuDS basins and filter drains could also act as pathways for contamination to enter groundwater. However, appropriate treatment and discharge arrangements for all drainage will be provided, while filter drains and SuDS basins are proposed to be lined. This is anticipated to prevent ingress of potential contaminants to groundwater and provide attenuation before discharging to surface waters. As such, impacts of **negligible** magnitude and **Neutral** significance are expected on groundwater quality with respect to these features.
- 10.4.33 Potential impacts of accidental spillages, uncontrolled run-off and increased sedimentation in relation to surface water features are discussed in **Chapter 11** and **Chapter 12**, where relevant.

Groundwater Abstractions and Private Water Supplies

- 10.4.34 Based on their distance from the Proposed Scheme, intervening topography and watercourses such as the River Truim, River Spey or others, and proximity to areas of excavation likely to intercept groundwater or bedrock; no direct or indirect impacts on the yield or quality of PWS or possible well features at Glentruim Estate (ABS 9.1a and ABS 9.1b), Invernahavon Holiday Park (ABS 9.2), Invertruim Cottage (ABS 9.3), Spey Bridge Caravan Park (ABS 9.5), Milton of Nuide (ABS 9.7), Inverton (ABS 9.8a), Gordonhall Farm (ABS 9.12), Balavil House (ABS 9.15) or Stoneybrae (PW 9.8) are anticipated.
- 10.4.35 For the remaining PWS and possible wells, the potential for impacts on their quality or yield as a result of groundwater interactions or possible rock blasting has been assessed as being negligible or absent across the Proposed Scheme. However, the supply source and/ or networks (i.e. pipelines) for several of the features are located within or physically cross the Proposed Scheme footprint. These are known or assumed to be associated with Ralia Café at ch. 42,050 (PW 9.15), Nuide Farm at ch. 45,600 and ch. 45,700 (ABS 9.6a and ABS 9.6b), Inverton at ch. 47,500 (ABS 9.8b), Ruthven Cottage and Knappach Cottage between ch. 48,500 and ch. 49,350 (ABS 9.9), and Balavil Estate, Lynchat Farm, East Lodge and Railway Cottage between ch. 52,600 and ch. 53,600 (ABS 9.13), with each supply source and network considered to be of **high** sensitivity. As they may be intercepted and directly affected by the Proposed Scheme footprint; the magnitude of impact on each is assessed to be potentially **major** based on the criteria in **Table 10-5**, resulting in impacts of **Large/ Very Large** significance. The agricultural supply at Nuide Farm (ABS 9.6b) may additionally be vulnerable to local dewatering of the surface water source location (MW 9.4 (Allt Eoghain)) from mainline cutting P9-MC-07, as identified in **Table 10-15**.
- 10.4.36 Direct impacts are also anticipated in relation to the PWS network for Coulintyre Cottage (ABS 9.16), which crosses the existing A9 at approximate ch. 56,200 and is of **high** sensitivity. However, it is noted that the property is physically located within the Proposed Scheme footprint and there is a possibility that it will be demolished as a result. Therefore, while a **major** magnitude and **Large/ Very Large** significance of impact is assessed, it is assumed that the PWS and associated network will be abandoned by the time construction works take place.
- 10.4.37 In addition to the above, consideration was given to the potential for impacts on the two PWS at Ruthven Farm (ABS 9.10) and Ruthven Steadings (ABS 9.11), both of which are **high** sensitivity. These are located in relatively close proximity (less than 150m) to the permanent and temporary works boundaries of the Proposed Scheme and comprise boreholes greater than 50m in depth. Based on the nearest areas of widening and cutting likely to intercept groundwater and bedrock, no potential impacts are expected on the yield of the supplies. Potential impacts on their quality as a result of spillage incidents during construction are also assessed as unlikely, but cannot be ruled out based on the potential for construction activities being undertaken cross and up-gradient of the borehole locations near Knappach. Groundwater may flow towards or with the direction of the River Spey in this area and the response zone of the borehole at Ruthven Farm (ABS 9.10) has not been confirmed. Based on the criteria in **Table 10-5**, depth of the boreholes

and their proximity, the potential magnitude of impact on water quality is assessed to be **minor**, resulting in impacts of **Slight/ Moderate** significance during the construction phase.

- 10.4.38 All other PWS and possible well features were identified as being no longer present or inactive, and with the exception of the former supply network associated with Ralia Beag and Ptarmigan Cottage (ABS 9.4), which crosses the existing A9 at approximate ch. 43,000, no interaction between the Proposed Scheme and possible former supply sources or pipelines are anticipated.

Groundwater Dependent Terrestrial Ecosystems

- 10.4.39 The Proposed Scheme has been designed at this stage to avoid or reduce disturbance of GWDTE. However, almost all proposed infrastructure is located within 100m of areas assessed to have at least a degree of groundwater dependence. Several have therefore proven to be unavoidable and are likely to be directly and/ or indirectly impacted.
- 10.4.40 The quantified extent of areas directly affected due to the Proposed Scheme footprint and wider land made available are detailed for each GWDTE habitat in **Appendix 10.2 (Volume 2)**, together with consideration of potential indirect effects from areas of widening or other cutting that are anticipated to intercept groundwater from **Table 10-13**. Where areas have been identified to be outwith zones of dewatering influence for the widenings or cuttings, these are qualitatively considered in the context of other works in the vicinity. The magnitude and significance of impact is based on combined consideration of the direct and indirect effects where relevant.
- 10.4.41 Based on these aspects and the criteria in **Table 10-5**, the magnitude of potential impacts on individual GWDTE (**medium to very high** sensitivity) are assessed to vary from **negligible to major** across the Proposed Scheme; with direct loss, disturbance and alteration in groundwater levels or flows, near surface hydrology and drainage throughout, but mainly where it is considered that the value of the individual areas would either not be affected, or would be, but not to a major degree. For the 208 GWDTE habitat areas assessed, this results in impacts of **Neutral** significance for 38 habitat areas (18%), **Slight to Slight/ Moderate** significance for 41 habitat areas (20%), **Moderate to Moderate/ Large** significance for 30 habitat areas (14%), **Large to Large/ Very Large** significance for 31 habitat areas (15%) and **Very Large** significance for one habitat area (less than 1%). No direct or indirect impacts are expected for the remaining 67 habitat areas (32%).
- 10.4.42 The impacts identified are predominantly in relation to habitats or mosaics considered to have a moderate dependence on groundwater throughout the Proposed Scheme, mainly comprising wet woodland, wet grasslands and bog; with areas of seepage, flushes and springs, fen, swamp and wet heath more locally affected. Partial and locally complete permanent loss of some areas is therefore anticipated due to the Proposed Scheme footprint, while disturbance in the wider land made available during construction and indirect impacts, may result in permanent or temporary effects, depending on the nature of the local vegetation and water supply mechanisms.
- 10.4.43 The ecological importance of habitats in the study area are outlined in **Chapter 12**, with regards environmental designations and the significance of ecological loss or disturbance of these. Based on this and the assessment presented in **Appendix 10.2 (Volume 2)**; no significant impacts have been identified in relation to GWDTE habitat areas that correspond to alder woodland and transition mire and quaking bog qualifying interest features of the Insh Marshes SAC. However, significant impacts have been identified in up to eight and 13 areas, respectively, that correspond to or contain components of the floodplain fen/ mire and vascular plant assemblage interest features of the River Spey – Insh Marshes Ramsar, SSSI and/ or the Insh Marshes NNR.

Groundwater Effects on Surface Water

- 10.4.44 Lowering of groundwater levels or dewatering in excavations can potentially affect nearby surface water features that interact with groundwater, by altering their baseflow component. It is assumed that a degree of hydraulic connectivity exists between the groundwater and surface water systems across the Proposed Scheme.
- 10.4.45 There are numerous minor watercourses along and adjacent to the Proposed Scheme, with several described in **Chapter 11** as comprising road drainage or ephemeral channels. Although their narrow size and low flow make them vulnerable to impact; a number of these are identified in **Appendix 11.1 (Volume 2)** as being man-made, with no significant hydrological importance to sensitive ecosystems and are therefore considered to be of **low** sensitivity. The majority of these features will also be replaced or diverted by the drainage network planned for the Proposed Scheme, with excavations considered unlikely to have significant indirect effects on them. This is also considered to be applicable to excavations for culverts and watercourse diversions.
- 10.4.46 For other watercourses and drainage features however, an assessment of potential impacts as a result of interaction with widenings and cuttings anticipated to intercept groundwater is summarised in **Table 10-15**. These are identified as per the feature referencing in **Chapter 11** and are illustrated in **Drawings 11.1 to 11.12 (Volume 3)**. Where groundwater is not anticipated to be encountered in areas of excavation from **Table 10-13**, the surface water features in the vicinity are considered unlikely to be indirectly impacted, so are excluded from the assessment for clarity. Otherwise, the magnitude of impact is based on consideration of the potential drawdown at the receptor against the intervening topography and the size (or volume of flow) of the surface water feature. Where no hydrological sensitivity has been assigned to a surface water feature within **Appendix 11.1 (Volume 2)**, these are assumed to be of very high sensitivity.

Table 10-15: Potential Impacts on Surface Water Features due to Interaction with Widening/ Cuttings

Surface Water Feature Ref.	Surface Water Feature Name	Chainage (approx.)	Nearest Earthworks Ref.	Sensitivity	Magnitude	Significance
MW 8.1	River Truim	ch. 40,000 to ch. 43,600	P9-MC-01	Very High	Negligible	Neutral
MW 9.1	River Spey	ch. 41,400 to ch. 56,600	P9-MC-06	Very High	Negligible	Neutral
MW 9.1	River Spey	ch. 41,400 to ch. 56,600	P9-MC-07	Very High	Negligible	Neutral
MW 9.1	River Spey	ch. 41,400 to ch. 56,600	P9-MC-13	Very High	Negligible	Neutral
MW 9.1	River Spey	ch. 41,400 to ch. 56,600	P9-CS-01	Very High	Negligible	Neutral
MW 9.10	Unnamed (drainage channel)	ch. 50,650 to ch. 50,750	CSA 7	Low	Minor	Neutral
MW 9.11	Unnamed	ch. 51,250	SuDS 531	Very High	Negligible	Neutral
MW 9.13a	Unnamed (drainage channel)	ch. 53,150	CSA 9	Very High	Minor	Moderate/ Large
MW 9.14	Raitts Burn	ch. 53,350	SuDS 534	Very High	Negligible	Neutral
MW 9.17	Unnamed	ch. 56,150	P9-MC-22	Very High	Negligible	Neutral
MW 9.17	Unnamed	ch. 56,150	P9-MC-25	Very High	Minor	Moderate/ Large
MW 9.17	Unnamed	ch. 56,150	SuDS 561	Very High	Minor	Moderate/ Large
MW 9.17	Unnamed	ch. 56,150	SuDS 563	Very High	Negligible	Neutral
MW 9.3	Caochan Riabhach	ch. 43,800 to ch. 44,000	P9-MC-06	High	Moderate	Moderate/ Large
MW 9.4	Allt Eoghainn	ch. 45,050 to ch. 46,300	P9-MC-07	High	Minor	Slight/ Moderate
MW 9.9a	Unnamed (ditch at Ruthven Barracks)	ch. 49,300	SuDS 493	Very High	Negligible	Neutral
P 9.15	Lochan an Tairbh	ch. 47,800 to ch. 48,000	P9-MC-13	High	Negligible	Neutral
P 9.19	Small pond (unnamed)	ch. 50,800	CSA 7	Very High	Negligible	Neutral
P 9.21	Pond (unnamed)	ch. 52,450	P9-MC-19	Very High	Negligible	Neutral
P 9.24	Small pond (unnamed)	ch. 55,050	P9-MC-22	Very High	Negligible	Neutral
P 9.29	Small pond (unnamed)	ch. 55,700	P9-MC-22	Very High	Negligible	Neutral
P 9.3	Loch Buidhe	ch. 43,600	P9-MC-06	Very High	Negligible	Neutral
P 9.4	Small pond (within channel of MW 9.3)	ch. 43,800	P9-MC-06	High	Negligible	Neutral
P 9.40	Pond (unnamed)	ch. 52,050	P9-MC-19	Very High	Negligible	Neutral
P 9.4a	Small pond (unnamed)	ch. 43,950	P9-MC-06	Very High	Negligible	Neutral
P 9.7	Small pond (unnamed)	ch. 46,000	SuDS 461	Very High	Negligible	Neutral

Surface Water Feature Ref.	Surface Water Feature Name	Chainage (approx.)	Nearest Earthworks Ref.	Sensitivity	Magnitude	Significance
W 9.1	Unnamed	ch. 40,050	P9-MC-01	Low	Negligible	Neutral
W 9.10	Unnamed (drainage channel)	ch. 45,750	P9-MC-07	Low	Minor	Neutral
W 9.11	Unnamed (ephemeral channel)	ch. 46,050	SuDS 461	Very High	Minor	Moderate/ Large
W 9.15	Unnamed (tributary to Lochan an Tairbh)	ch. 48,050	P9-MC-13	High	Negligible	Neutral
W 9.15a	Unnamed (ephemeral channel)	ch. 48,380	P9-MC-13	Low	Minor	Neutral
W 9.22	Unnamed (drainage channel)	ch. 50,900	CSA 7	Very High	Negligible	Neutral
W 9.26	Unnamed	ch. 51,400	SuDS 521	Very High	Negligible	Neutral
W 9.3	Unnamed	ch. 40,750	P9-MC-01	Low	Minor	Neutral
W 9.30	Unnamed (drainage channel)	ch. 52,850	P9-BL-03	Low	Minor	Neutral
W 9.33	Unnamed	ch. 53,750	P9-MC-21	Medium	Negligible	Neutral
W 9.33	Unnamed	ch. 53,750	SuDS 537	Medium	Minor	Slight
W 9.34	Unnamed	ch. 54,250	P9-MC-22	Low	Moderate	Slight
W 9.35	Unnamed (drainage channel)	ch. 54,750 to ch. 55,000	P9-MC-22	Very High	Negligible	Neutral
W 9.39	Unnamed (drainage channel)	ch. 55,600	P9-MC-22	Very High	Negligible	Neutral
W 9.39	Unnamed (drainage channel)	ch. 55,600	P9-CC-01	Very High	Negligible	Neutral
W 9.41	Unnamed (drainage channel)	ch. 56,200	SuDS 563	Very High	Negligible	Neutral
W 9.44	Unnamed	ch. 56,500	P9-MC-25	Very High	Negligible	Neutral
W 9.44	Unnamed	ch. 56,500	P9-MC-26	Very High	Negligible	Neutral
W 9.48	Unnamed (drainage channel)	ch. 43,200	P9-NJ-02	Low	Minor	Neutral
W 9.5	Unnamed	ch. 43,450	P9-NJ-02	Low	Minor	Neutral
W 9.50	Unnamed (ephemeral channel)	ch. 44,160	P9-MC-06	Low	Negligible	Neutral
W 9.51	Unnamed (ephemeral channel)	ch. 44,650	P9-MC-07	Very High	Minor	Moderate/ Large
W 9.7	Unnamed	ch. 44,000 to ch. 44,650	P9-MC-06	Low	Minor	Neutral
W 9.7a	Unnamed (drainage issues)	ch. 44,350	P9-MC-07	Low	Moderate	Slight
W 9.9	Unnamed (tributary to Allt Eoghainn)	ch. 45,550 to 46,000	P9-MC-07	Very High	Negligible	Neutral
W 9.48	Unnamed (drainage channel)	ch. 43,200	P9-MC-05	Low	Moderate	Slight
W 9.49a	Unnamed	ch. 42,900	P9-MC-05	Low	Minor	Neutral

Potential Contamination

- 10.4.47 A number of potential contamination sources have been identified in the study area, as shown in **Drawings 10.35 to 10.46 (Volume 3)**. An assessment of each source is presented in **Appendix 10.4 (Volume 2)** within the context of a preliminary CSM and with reference to pollutant linkages identified in **Table 10-7**. Based on the criteria in **Table 10-8 to Table 10-10**, the CSM evaluates the level of potential risk (significance) that may be present in relation to impacts from each source, as a direct result of construction or operational activities associated with the Proposed Scheme.
- 10.4.48 In this respect, there are considered to be two potential ways in which the Proposed Scheme may interact with potential contamination, as follows:
- direct disturbance of potential contamination sources (i.e. those within the Proposed Scheme footprint or permanent and temporary works boundaries)
 - indirect disturbance of nearby potential contamination sources as a result of construction of the Proposed Scheme (i.e. interception within areas of excavation).
- 10.4.49 Direct interaction may occur with potential sources including the existing A9 carriageway (CK-01), decommissioned electricity pylons (CK-03), areas of worked ground and former gravel pits or quarries (CK-05, CK-07, CK-10, CK-12, CK-13, CK-14, CK-20, CK-35, CK-40), Ralia Café and Picnic Area (CK-06), septic tanks at Balavil and Lynchat (CK-55, CK-57), potential radon hazard areas (CK-04) and elevated ground gas levels (CK-177). Based on the CSM assessment, this interaction is considered likely to occur and may affect human receptors during construction (PL1 to PL4), with **minor to medium** consequence and potential impacts of **Low to Moderate** significance. Interaction with the same sources may also occur during operation (PL13 to PL16) with similar consequence, but lower likelihood and **Very Low to Moderate/ Low** significance.
- 10.4.50 Where made ground material is excavated and temporarily stored during construction (including materials from demolished structures or the existing A9 carriageway and embankment), this may additionally represent potential risks to human receptors (PL1 and PL3), water environment and ecological receptors such as groundwater, surface water, GWDTE and livestock (PL5 to PL9 and PL11) or property receptors such as PWS (PL7), buried concrete and services (PL12). In the absence of mitigation, the potential of this occurring has been assessed as likely, and of **minor to medium** consequence during construction. Potential risks to the same receptors during operation are possible (PL13, PL15, PL17 to PL21, and PL23 to PL24) if the materials were re-used, and are assessed to be of similar consequence, but lower likelihood. Potential impacts are therefore identified to be of **Low to Moderate** significance during construction and **Very Low to Moderate/ Low** significance during operation.
- 10.4.51 Indirect impacts may occur where areas of widening and cutting intercept groundwater during construction, as they could draw local potential contaminated groundwater towards them or mobilise potential contaminated water within or adjacent to the footprint. This may then impact human health (PL1 and PL13), surface water, GWDTE or PWS receptors through migration (PL7) and require discharge during construction and operation (PL10 and PL22). Potential sources in relation to this principally include the HML railway (CK-02), decommissioned electricity pylons (CK-03), Meadowside Quarry (CK-38) and local inorganic and organic contaminant levels recorded in groundwater chemical testing results.
- 10.4.52 The preliminary CSM assessment for each relevant source area, based on the potential for excavations in proximity to draw in or mobilise contaminated groundwater is presented in **Appendix 10.4 (Volume 2)**. During construction, the potential impacts are assessed to be of **Low to Moderate** significance based on potential for contamination presence and the proximity of

sensitive receptors. Similar potential impacts during operation are proportional in terms of consequence, but one level lower in terms of likelihood. As such, impacts of between **Very Low** and **Moderate/ Low** significance are expected.

10.5 Mitigation

- 10.5.1 Based on the potential impact assessment, Standard Mitigation measures for the Proposed Scheme followed by Project Specific Mitigation considerations are detailed in **Table 10-16**. These measures consider best practice, current legislation and guidance to further avoid, reduce or offset the potential impacts identified, where possible.
- 10.5.2 The Standard Mitigation measures are based upon those being applied across the A9 Dualling Programme and will be developed by the Contractor alongside the Project Specific Mitigation and relevant management systems to structure, monitor, control and communicate implementation, including a Construction Environmental Management Plan (CEMP).

Table 10-16: Standard and Project Specific Mitigation Commitments – Geology, Soils and Groundwater

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required
Standard A9 Mitigation					
SMC-G1	Throughout Proposed Scheme	Pre-Construction	Prior to construction, consultation will be undertaken with the relevant local authorities and SEPA regarding works in relation to land affected by contamination to support the obligations set out in 'Planning Advice Note 33: Development of Contaminated Land' (Scottish Government, 2000). Any remedial action undertaken in relation to land affected by contamination will be carried out under the appropriate remediation licencing.	To reduce impacts from contaminated land sources.	Consultation with THC (and SEPA as required).
SMC-G2	Throughout Proposed Scheme	Pre-Construction	Prior to construction and where potential contamination has been identified, further site investigations sufficient to determine the extent and type of contaminants present will be undertaken as necessary to inform identification of appropriate construction methods and any additional mitigation.	To determine the extent and type of contaminants present and to inform identification of appropriate construction methods and any additional mitigation.	None required
SMC-G3	Throughout Proposed Scheme	Pre-Construction and Construction	Prior to construction, appropriate health and safety and waste management procedures for working with potentially contaminated soils will be established. Waste management procedures will take account of inter alia: Waste Management Licence (Scotland) Regulations 2011 (as amended by the Waste Management Licensing (Scotland) Amendment Regulations 2016), HSE Guidance Note MS31 (HSE, 2012) and the Health and Safety Commission Approved Code of Practice and Guidance Note. These procedures will be implemented as appropriate during construction.	To ensure appropriate health and safety and waste management procedures for working with potentially contaminated soils are followed.	None required
SMC-G4	Throughout Proposed Scheme	Construction, Post-Construction and Operation	Risks to construction and maintenance staff working with/near contaminated land will be mitigated by the implementation of Mitigation Item SMC-G3 in combination with the adoption of appropriate systems of work, including personal protective equipment (PPE) as a last resort. In the event that unrecorded contamination is encountered, works should be stopped and the working procedures reassessed to confirm the working methods remain appropriate. Construction staff will be trained to identify asbestos containing material.	To reduce impacts from contaminated land sources and confirm the safety of construction and maintenance staff.	None required
SMC-G5	Throughout Proposed Scheme	Construction	Appropriate training will be provided for personnel involved in earthworks activities to enable implementation of a watching brief to identify presence of previously unidentified contamination.	To identify potential presence of previously unidentified contamination.	None required
SMC-G6	Throughout Proposed Scheme	Pre-Construction and Construction	Where required, landowner consultation and site visits will be undertaken to confirm the location of septic tanks and associated infrastructure. Where septic tanks are located within the LMA they will be relocated subject to discussion and agreement with the affected landowner(s).	To mitigate the loss of any septic tanks.	Approval from landowners
SMC-G7	Throughout Proposed Scheme	Construction	To prevent cross contamination and pollution from piling works undertaken in areas of land affected by contamination, the Contractor will undertake a Piling Risk Assessment and adhere to appropriate guidance including the 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention, National Groundwater and Contaminated Land Centre Report NC/99/77'.	To prevent cross contamination and pollution from piling works undertaken in areas of land affected by contamination.	None required

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required
SMC-G8	Throughout Proposed Scheme	Construction	Excavated soils deemed unsuitable for reuse will be assessed in line with the 'Waste Classification: Guidance on the Classification and Assessment of Waste' (Technical Guidance WM3) (Natural Resources Wales, SEPA, Northern Ireland Environment Agency, Environment Agency, May 2015) to determine whether they are hazardous or non-hazardous. This will establish the most appropriate and cost-effective waste stream for the waste materials.	To determine whether disposed soils are hazardous or non-hazardous.	None required
SMC-G9	Throughout Proposed Scheme	Pre-Construction	To maximise the re-use of site-won materials on-site (and minimise the need for disposal of waste in line with the principles of the "Waste Hierarchy") whilst ensuring that no risks are posed to human health nor the water environment, a soil reuse assessment will be undertaken prior to construction. The soil reuse assessment will identify any potential risks posed to both human health and the water environment from potentially contaminated soils reused throughout the Proposed Scheme.	To identify any potential risks posed to human health and the water environment. In addition, this mitigation item would maximise re-use of site-won materials on-site and minimise the need for disposal of waste in line with the principles of the "Waste Hierarchy" through re-use of excavation arisings (refer to Mitigation Item M3).	None required
SMC-G10	Throughout Proposed Scheme	Construction	Where peat is encountered during construction, it will be excavated, stored and re-used if possible, taking cognisance of 'Development on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste' (Scottish Renewables and SEPA, 2012) and The Waste Management Licensing (Scotland) Regulations 2011. This will be captured in a Peat Management Plan that will be developed by the Contractor. Does not apply to Project 9, more specific mitigation required for this Scheme.	To comply with relevant waste management practices under The Waste Management Licensing (Scotland) Regulations 2011 and reduce impacts on peatlands.	Consultation with SEPA
SMC-G11	Throughout Proposed Scheme	Pre-Construction and Construction	Where concrete materials are proposed to be used, appropriate guidance such as 'Building Research Establishment (BRE) SD1:2005' and 'British Standard (BS) BS8500' should be followed to ensure that ground conditions are appropriate for the use of concrete at each given location.	To ensure that ground conditions are appropriate for the use of concrete at each given location.	None required
SMC-G12	Contamination sources: (CK-177)	Pre-Construction, Construction, Post-Construction and Operation	Where potential pollutant pathways for ground gas have been identified, a ground gas monitoring programme will be developed prior to construction in adherence to 'BS 8485:2015 - Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings". This will include an assessment of gassing issues following receipt of additional ground gas monitoring results at selected boreholes. Appropriate working methods will be developed and adopted during below ground site construction works (including piling works and excavations). This should include as a minimum, gas monitoring undertaken prior to any entry into excavations, confined spaces or below ground structures and use of PPE as a last resort. If ground gas issues are identified during construction, further post construction monitoring will be undertaken and/or appropriate gas protection measures will be incorporated into the final design.	To mitigate against potential impacts on human health during construction, and on Off Site Receptors (Local residents, transient traffic (foot, road and rail traffic) in the surrounding area) due to ground gas.	None required

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required
SMC-G13	Throughout Proposed Scheme	Construction	Unless it can be demonstrated by the Contractor via a Quantitative Risk Assessment that no water quality impacts will occur due to leaching from SuDS retention ponds and detention basins, operational SuDS features will be lined. Any potential water quality impacts due to leaching from SuDS features will be addressed through the CAR process.	To mitigate against potential impacts on water quality due to leaching from SuDS features.	SEPA
SMC-G14	Throughout Proposed Scheme	Construction	Storage of excavated soils and made ground will be minimised on site (spatially and in duration) and storage areas will be appropriately lined, with adequate drainage management in place.	To ensure that no polluted water percolates into the ground or contaminated run-off is generated.	None required
SMC-G15	Throughout Proposed Scheme	Pre-Construction	Risk assessments will be undertaken before explosives can be used on site.	To minimise or control the impact of blasting on bedrock geology.	None required
<i>n/a (note)</i>	<i>n/a</i>	<i>n/a</i>	<i>Further to the above, the implementation of Mitigation Items detailed in Chapter 11 (Road Drainage and the Water Environment) and the measures detailed in Chapter 16 (Air Quality).</i>	<i>To mitigate the water pollution risk to groundwater and avoid the creation of a statutory nuisance associated with dust and air pollution when working with contaminated land.</i>	<i>n/a</i>
Project Specific Mitigation					
P09-G1	Throughout Proposed Scheme	Pre-Construction, Construction and Post-construction	Prior to construction, a suitably qualified (or team of suitably qualified) and experienced Environmental Clerk of Works (EnvCoW) shall be appointed by the Contractor to oversee implementation of mitigation and monitoring relating to soils, potential contamination, groundwater, PWS and the management of waste materials. A suitably qualified (or team of suitably qualified) and experienced Ecological Clerk of Works (ECoW) shall also be appointed prior to construction, to oversee and provide specific inputs to the implementation of proposed mitigation and monitoring relating to peat and GWDTE.	To oversee implementation of mitigation and monitoring relating to soils, potential contamination, groundwater, PWS, the management of waste materials, peat and GWDTE.	None required
P09-G2	ch. 43,600 to ch. 44,025 ch. 44,425 to ch. 45,625 ch. 54,300 to ch. 56,000	Design, Pre-Construction and Construction	Naturalistic rock cutting may be possible in areas of widening and cutting identified as being likely to intercept bedrock, the extent of which shall be determined during the detailed design by the Contractor and following risk assessment (Mitigation Item SMC-G15). During construction, rock mapping and inspections shall be undertaken by a suitably qualified and experienced engineering geologist appointed by the Contractor in those areas determined, with the cuts being profiled to be as natural as possible and minimise visible engineered elements.	To review stability and minimise the requirement for meshing or other stabilisation measures within final rock cut profiles.	None required

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required
P09-G3	ch. 47,800 to ch. 48,050	Construction	<p>An exclusion zone will be established during the construction period at Lochan an Tairbh, as shown in Environmental Mitigation Drawing 6.6 (Volume 3), to restrict construction activities and permanent works to only what is necessary for the establishment of the pre-earthworks drainage, watercourse diversions and carriageway in the vicinity. During the construction of the pre-earthworks drainage, watercourse diversions and carriageway, the Contractor shall minimise disturbance of the natural soil profile and landform in the area as far as is practicable and re-instate work areas that are utilised appropriately.</p> <p>Damage to water quality and sediments within the lochan shall be avoided through set-backs as required and appropriate working procedures shall be adopted as per Mitigation Items SMC-W1 to SMC-W9 and SMC-W13 to SMC-W17 in Chapter 11 in relation to pollution prevention, sediment control and drainage.</p>	To minimise disturbance to the lochan, soils, landform, sediment and water quality	Consultation with SNH, CNPA and SEPA
P09-G4	Throughout Proposed Scheme	Pre-Construction and Construction	The Contractor shall develop a Soil Management Plan prior to construction, for implementation during construction, with cognisance of the requirements identified in relation to peaty soils and peat (Mitigation Items P09-G5 and P09-G6) and adopting principles from the 'Scottish Soil Framework' (Scottish Government, 2009) and other voluntary or industry regulated Codes of Practice, including 'Promoting the Sustainable Reuse of Greenfield Soils in Construction' (SEPA, 2010) and the 'Construction Code of Practice for the Sustainable Use of Soils on Construction Sites' (DEFRA, 2009).	To document and ensure that soil resources and soils of conservation value are excavated, managed, re-used and replaced sustainably and appropriately	Consultation with SEPA
P09-G5	Throughout Proposed Scheme	Pre-Construction, Construction and Post-Construction	<p>Prior to construction, the Contractor shall refine the OPMP (Appendix 10.6 (Volume 2) of the ES) for implementation prior to, during and following construction as the Construction-stage Peat Management Plan (PMP).</p> <p>The Construction-stage PMP shall adopt the principles and best practice measures detailed in the OPMP, with refinements made by the Contractor to include the establishment of detailed site-specific method statements related to construction techniques and locations, estimated excavation volumes, excavation procedures, temporary works activities, temporary storage, transportation, handling, proposed peat re-uses and method statements for this.</p> <p>Monitoring requirements and timescales for prior to, during and following construction, particularly with regards re-use works, shall be established and implemented by the Contractor as necessary, with all refinements made taking cognisance of best practice in 'Development on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste' (Scottish Renewables and SEPA, 2012) and others, as necessary.</p>	To comply with relevant waste management practices under The Waste Management Licensing (Scotland) Regulations 2011 and manage, reduce and monitor impacts on peat and peaty soils	Consultation with SNH, SEPA and CNPA required to agree on the Construction-stage Peat Management Plan (PMP) and any proposed peat re-uses
P09-G6	Throughout Proposed Scheme	Pre-Construction, Construction and Post-Construction	<p>Through adoption and refinement of the OPMP, the Contractor shall identify and propose environmentally beneficial re-uses of peat that is excavated during construction.</p> <p>Following re-use, dedicated monitoring of the water table and vegetation in the re-use areas adopted shall be undertaken by the Contractor where necessary (Mitigation Item P09-G5) and the requirements for additional treatment work such as but not limited to, seeding, compaction, tapering and removal of invasive species, established on an ongoing basis in consultation with SEPA, SNH and CNPA.</p>	To provide mitigation for peat excavation and disturbance	See Mitigation Item P09-G5

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required
P09-G7	Throughout Proposed Scheme	Design, Pre-Construction and Construction	Where peat conditions and depths permit, the Contractor shall design and include measures (such as floated access tracks and piled or bridged solutions for embankments or structures) to avoid or minimise peat excavation and disturbance. This shall take account of the unique peat characteristics, and follow guidance on the design, duration and timing of construction, the sequencing of construction and hydrology considerations in 'Floating Roads on Peat: A Report into Good Practice in Design, Construction and Use of Floating Roads on Peat with particular reference to Wind Farm Developments in Scotland' (SNH/ FCS, 2010) and others, as necessary.	To reduce peaty soil and peat disturbance and resultant excavation volumes	See Mitigation Item P09-G5
P09-G8	Throughout Proposed Scheme	Pre-Construction and Construction	Temporary storage of excavated peat shall be avoided by transporting it to identified re-use locations as soon as is practicable, and the time spent in storage shall be kept to a minimum where possible. Where this is not possible during construction, the Contractor shall take account of the Preliminary Peat Landslide Risk Assessment findings (Appendix 10.5 (Volume 2) of the ES), undertake additional quantitative assessment where necessary and identify appropriate storage areas for excavated peat, including, varying or additional to those provisionally highlighted in Drawings 10.47 to 10.58 (Volume 3) .	To minimise peat volumes in storage and the likelihood of drying.	See Mitigation Item P09-G5
P09-G9	Throughout Proposed Scheme	Pre-Construction and Construction	Where excavated peat does require temporary storage, the areas for this shall avoid being near watercourses through appropriate set-backs. Areas of GWDTE assessed as likely moderate and/ or highly dependent on groundwater in Appendix 10.2 (Volume 2) of the ES shall also be avoided where possible – particularly areas of or containing seepage, flush, spring, fen and swamp vegetation. Where possible, peat will be extracted and relocated as 300mm to 500mm deep turves. If peat turves need to be stored for any length of time, they will be stored vegetation side up, stacked no more than 1.00m high, and monitored during all weather conditions and kept wet as necessary to prevent them from drying out.	To minimise peat volumes in storage, the likelihood of drying and potential effects on GWDTE	See Mitigation Item P09-G5
P09-G10	Throughout Proposed Scheme	Design, Pre-construction, Construction and Post-Construction	For temporary construction-stage SuDS and related drainage, the Contractor shall avoid areas of deep peat and GWDTE assessed as being likely moderate and/ or highly dependent on groundwater in Appendix 10.2 (Volume 2) of the ES where possible. This shall be achieved through micro-siting during detailed design and the use of above-ground solutions requiring no or limited excavation, such as siltbusters, where possible, during construction. Areas of peat or GWDTE habitat which are unavoidable and in which excavation is required for temporary SuDS and drainage shall be re-instated by the Contractor as soon as possible following the completion of construction works. Such re-instatement shall return the areas to their former habitat type as far as is practicable, with any seeding and planting of bare ground areas undertaken as soon as possible after completion of the construction works using species appropriate to the environment and of local provenance.	To reduce peaty soil and peat disturbance, resultant excavation volumes and re-instate areas which are disturbed	See Mitigation Item P09-G5

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required
P09-G11	Throughout Proposed Scheme	Design, Construction and Post-Construction	For temporary haul roads or access tracks required during construction, the Contractor shall avoid areas of deep peat and GWDTE assessed as being likely moderate and/ or highly dependent on groundwater in Appendix 10.2 (Volume 2) of the ES where possible. Where unavoidable, floated track construction shall be considered where conditions and depths permit, with guidance from 'Floating Roads on Peat: A Report into Good Practice in Design, Construction and Use of Floating Roads on Peat with particular reference to Wind Farm Developments in Scotland' (SNH/ FCS, 2010) and others, as necessary. All temporary haul roads and access tracks created during construction shall be fully re-instated by the Contractor following construction.	To reduce peaty soil and peat disturbance, resultant excavation volumes and re-instate those areas which are temporarily disturbed	See Mitigation Item P09-G5
P09-G12	Throughout Proposed Scheme	Design, Pre-Construction, Construction and Post-Construction	Where potential peat landslide or bog burst risks have been identified in the Preliminary Peat Landslide Risk Assessment and Preliminary Risk Register in Appendix 10.5 (Volume 2) of the ES, the Contractor shall undertake additional quantitative assessment of these where necessary prior to construction and follow guidance within 'Peat Landslide Hazard and Risk Assessments: Best Practice for Proposed Electricity Generation Developments' (Scottish Government, 2017) to inform additional micrositing of Proposed Scheme elements during detailed design if needed, and to determine and implement any required mitigation such as catch ditches, fences, walkovers and inspections during and following construction.	To identify and mitigate against potential peat landslide or bog burst risks	Consultation with SNH, SEPA and CNPA
P09-G13	Throughout Proposed Scheme	Pre-Construction	A number of widening or other cuttings have been identified as having the potential to intercept groundwater, while sub-artesian conditions may be encountered during piling for the River Spey bridge crossing. Volumes of groundwater drainage will need to be considered in the context of potential groundwater abstraction CAR licenses prior to construction works commencing.	To comply with CAR license requirements and protect the water environment	Consultation with and approval from SEPA
P09-G14	Throughout Proposed Scheme	Design, Pre-Construction, Construction and Operation	Additional detailed assessment will be undertaken for areas of widening, cutting or other works anticipated to result in indirect impacts on GWDTE and surface water features. This shall be completed prior to construction using all available GI data, including any available additional monitoring and testing data from the Preliminary, Detailed and Supplementary GI. Based on this, a specific GWDTE and surface water monitoring and mitigation plan will be developed, with drainage designs, groundwater exclusion, containment or other control measures determined by the Contractor during detailed design and implemented during construction to reduce drawdown and indirect impacts at affected receptors and to maintain or facilitate groundwater through-flows during construction and operation where necessary. Permeable fill materials should also be used in embankment construction with cross-formation drains to maintain through-flows where possible, taking cognisance of the findings from pre-construction drainage surveys (Mitigation SMC-CP10 in Chapter 8). Drainage and pumping from excavations or other works will otherwise be carefully monitored during construction, with additional mitigation such as redirecting abstracted water to affected receptors implemented as necessary.	To determine GWDTE and surface water risks, assess changes in groundwater level and quality and ensure that GWDTE and surface waters are protected	Consultation with SEPA

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required
P09-G15	Throughout Proposed Scheme	Design, Pre-Construction and Construction	A differential settlement assessment shall be undertaken by the Contractor prior to construction in excavation areas that have the potential to intercept groundwater and which are located in proximity to existing infrastructure. This shall be completed using all available GI data, including any additional available monitoring data from the Preliminary, Detailed and Supplementary GI. Should potential settlement risks be identified, mitigation measures shall be implemented by the Contractor during construction where necessary and may include monitoring of groundwater level variations, implementation of condition surveys and monitoring of infrastructure.	To determine if adjacent or surrounding infrastructure is at risk of settlement and implement mitigation where required	None required
P09-G16	Throughout Proposed Scheme	Design, Pre-Construction and Construction	The Contractor shall review areas of groundwater likely to be intercepted by excavations or other works and implement treatment as required prior to discharge. This shall be completed using all available GI data, including any available additional groundwater monitoring and testing data from the Preliminary, Detailed and Supplementary GI; in the preparation of discharge licensing considerations. Containment facilities and discharge locations for abstracted groundwater during construction shall be defined by the Contractor taking water quality characteristics into account.	To determine treatment and discharge requirements for intercepted groundwater	Consultation with SEPA
P09-G17	Throughout Proposed Scheme	Construction	Any excavations within or alongside areas of deep peat or blanket bog habitat should be bunded with sheets of plastic or metal sheet piling to assist retaining water and preventing local drainage of the adjacent or surrounding peat mass margins where practicable.	To minimise dewatering of areas of peat	See Mitigation Item P09-G5
P09-G18	Throughout Proposed Scheme	Pre-Construction, Construction and Post-Construction	A groundwater monitoring network shall be established within and adjacent to areas of GWDTE identified to be at potential risk of impact, with monitoring completed in accordance with 'LUPS-GU31 Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems, Version 3' (SEPA, 2017). Such monitoring shall involve groundwater level and quality readings, as well as repeated NVC surveys based on the GWDTE monitoring and mitigation plan developed in Mitigation Item P09-G14 .	To determine GWDTE risks, assess changes in groundwater level and quality and ensure GWDTE are protected	Consultation with SEPA
P09-G19	Throughout Proposed Scheme	Pre-Construction, Construction and Post-Construction	The Contractor shall establish a Groundwater and Surface Water Management Plan with associated monitoring programme prior to construction, to be adhered to during construction, and post construction, as required by the regulatory bodies. This shall be prepared with cognisance of Mitigation Items SMC-W1 to SMC-W17 detailed in Chapter 11 and monitoring requirements related to GWDTE where necessary (Mitigation Item P09-G14).	To document and ensure mitigation and monitoring measures are in place to protect the water environment	Consultation with SEPA

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required
P09-G20	Throughout Proposed Scheme	Design, Pre-Construction and Construction	<p>Mitigation Items SMC-W3 and SMC-W6 to SMC-W8 detailed in Chapter 11 will offer protection of the groundwater environment, wetlands and GWDTE in relation to control of sediments, run-off and pollution prevention. To avoid hydrological damage and to maintain hydrological connectivity between and within wetland and GWDTE habitats, minimum buffer zones of 10m shall also be established as far as practicable by the Contractor around watercourses and otherwise, sensitive features such as areas of swamp, standing or moving water (seepages, flushes and springs). The buffer zone should be marked out on the ground and avoided where possible. Any works within the buffer zone shall be supervised by a suitably qualified and experienced ECoW appointed by the Contractor and shall be planned to maintain unpolluted and natural water flows.</p>	To mitigate and control potential effects on GWDTE during construction	Consultation with SEPA
P09-G21	Private Water Supplies: Nuide Farm (ABS 9.6a, ABS 9.6b), Inverton (ABS 9.8b), Ruthven Cottage/ Knappach Cottage (ABS 9.9) and Balavil Estate (ABS 9.13)	Pre-Construction and Construction	<p>Additional surveys shall be undertaken prior to construction, to confirm the exact location and extent of the PWS source and networks within the LMA for the properties at Nuide Farm (ABS 9.6a and ABS 9.6b), Inverton (ABS 9.8b), Ruthven Cottage and Knappach Cottage (ABS 9.9) and Balavil Estate, Lynchat Farm, East Lodge and Railway Cottage (ABS 9.13).</p> <p>If impacts to a PWS source and/ or network are confirmed, the Contractor shall incorporate protective measures during construction, combined with monitoring (with permission from landowners and residents), to ensure the PWS infrastructure is not damaged during construction or in the long-term by the Proposed Scheme. If protection is not possible, alternative sources of water or replacement/ diverted networks shall be put in place.</p> <p>The Contractor will be required to prepare a specific monitoring plan and mitigation strategy for each supply, in consultation with affected landowners, residents, THC and SEPA.</p>	To protect and monitor PWS and implement corrective actions as necessary	Liaison with landowners and residents, and consultation with THC and SEPA
P09-G22	Private Water Supplies: Ruthven Farm (ABS 9.10) and Ruthven Steading (ABS 9.11)	Pre-Construction and Construction	<p>Mitigation Items SMC-W3 and SMC-W6 to SMC-W8 detailed in Chapter 11 will offer protection of the groundwater environment and PWS. However, the borehole PWS at Ruthven Farm (ABS 9.10) and Ruthven Steading (ABS 9.11) identified as potentially at risk of quality impacts shall also be monitored, with permission from the landowners and residents.</p> <p>Should a significant impact on a PWS be confirmed, corrective actions will be undertaken by the Contractor and could include the provision of a temporary or long-term alternative source of water. To this effect, the Contractor will be required to prepare a specific monitoring plan and mitigation strategy for each supply in consultation with affected landowners, residents, THC and SEPA.</p>	To monitor PWS and implement corrective actions as necessary	Liaison with landowners and residents, and consultation with THC and SEPA

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required
P09-G23	Private Water Supplies: Torra Dhaimh/ Ralia Café (PW 9.15)	Pre-Construction and Construction	<p>Additional surveys shall be undertaken prior to construction, to confirm the location, status, depth and use of the possible water supply feature at Torra Dhaimh/ Ralia Café (PW 9.15) and any associated supply network within the LMA.</p> <p>If this is confirmed as an active water supply source and significant impacts are identified, the Contractor shall incorporate protective measures, combined with monitoring (with permission from the landowner and residents), to ensure the PWS infrastructure is not damaged during construction or in the long-term by the Proposed Scheme. If protection is not possible, an alternative source of water or replacement/ diverted network shall be put in place. If the feature is confirmed as redundant, decommissioning shall be undertaken by the Contractor in accordance with 'Good Practice for Decommissioning Redundant Boreholes and Wells' (SEPA, 2010) and others, as necessary.</p> <p>The Contractor will be required to prepare a specific monitoring plan and mitigation strategy in consultation with affected landowners, residents, THC and SEPA.</p>	To protect and monitor PWS and implement corrective actions or decommissioning as necessary	Liaison with landowner and residents, and consultation with THC and SEPA
P09-G24	Private Water Supplies: Ralia Beag/ Ptarmigan Cottage (ABS 9.4) and Coulintyre Cottage (ABS 9.16)	Pre-Construction and Construction	<p>Additional surveys shall be undertaken prior to construction, to confirm the exact location and extent of the PWS source and networks within the LMA for the properties at Ralia Beag and Ptarmigan Cottage (ABS 9.4) and Coulintyre Cottage (ABS 9.16). As these are known to be or assumed as likely to be no longer active, decommissioning of the networks within the LMA shall be undertaken by the Contractor in accordance with 'Good Practice for Decommissioning Redundant Boreholes and Wells' (SEPA, 2010) and others, in consultation with the affected landowner, residents, THC and SEPA where necessary.</p>	To decommission redundant PWS and networks that may be affected by construction	Liaison with landowner and residents, and consultation with THC and SEPA
(note)	Refer to Chapters 11 and 12 for locations	Refer to Chapters 11 and 12	<p>Further to the above, Mitigation Items P09-E6, P09-E10, P09-E11, P09-E12, P09-E13, P09-E24, P09-E25, P09-E26 and P09-E30 detailed in Chapter 12 (Ecology and Nature Conservation) will be implemented in relation to construction works and peaty soil, peat and wetland habitats, habitat and species management, habitat re-instatement and proposals to create circa 36 ha of wader habitat (including wet grasslands, marshy grasslands and other riparian habitat enhancements) at the Dellmore of Kingussie, as outlined in Appendix 6.2 (Volume 2).</p> <p>The implementation of Mitigation Items detailed in Chapter 11 (Road Drainage and the Water Environment) will also mitigate pollution-related risks to groundwater, GWDTE and PWS.</p>	To reduce temporary impacts on peaty soil, peat or wetland-based habitats and deliver specific mitigation measures to re-instate or create habitats that are impacted	n/a

Monitoring Requirements

- 10.5.3 Standard and Project Specific Mitigation commitments will be monitored prior to, during and following construction via the CEMP (**Mitigation Item SMC-S1 in Chapter 21**) and additional plans as required. This shall include all aspects related to soil, geodiversity, groundwater, GWDTE, surface water and PWS as necessary and outlined in **Table 10-16**.
- 10.5.4 Aspects related to peat stability shall be subject to monitoring during and following construction, as identified by the Preliminary Peat Landslide Risk Assessment in **Appendix 10.5 (Volume 2)** and requirements will be further defined by the Contractor following additional quantitative assessment prior to construction commencing. Areas of peat re-use and re-instatement shall also be monitored during and following construction in accordance with the recommendations in the OPMP in **Appendix 10.6 (Volume 2)**; which shall be further developed by the Contractor prior to construction in consultation and agreement with SEPA, SNH and CNPA.
- 10.5.5 Suitably qualified and experienced EnvCoWs and ECoWs will be appointed to oversee mitigation and monitoring implementation, as well as emerging issues during construction (**Mitigation Item P09-G1**). Monitoring details, frequencies and reporting requirements for all aspects will be agreed with SEPA, SNH, CNPA and others as required, and will be tailored by the Contractor to provide meaningful indications of the ongoing works, impacts and mitigation implementation.

10.6 Residual Impacts

- 10.6.1 Following implementation of mitigation and associated monitoring; potential impacts in relation to geology, soils and groundwater for the Proposed Scheme will be avoided, reduced or off-set as far as practicable. Residual impacts are those that remain once the measures have been implemented, and are summarised in **Table 10-17** with reference to the Standard and/ or Project Specific Mitigation proposed for them from **Table 10-16**.
- 10.6.2 No residual impacts are expected in relation to PWS features at Glentruim Estate (ABS 9.1a and ABS 9.1b), Invernahavon Holiday Park (ABS 9.2), Invertruim Cottage (ABS 9.3), Spey Bridge Caravan Park (ABS 9.5), Milton of Nuide (ABS 9.7), Inverton (ABS 9.8a), Gordonhall Farm (ABS 9.12), Balavil House (ABS 9.15) or Stoneybrae (PW 9.8). Potential impacts on superficial geology, solid geology and mineral extraction are also expected to remain as Neutral or Neutral/ Slight, with no specific mitigation measures considered necessary. These aspects are therefore excluded from **Table 10-17** for clarity, where relevant.

Table 10-17: Residual Impacts – Geology, Soils and Groundwater

Receptor	Sensitivity	Pre-Mitigation Impact Significance	Mitigation	Post-Mitigation Residual Impact Significance
Designated Geological Receptors and Features of Geodiversity Interest				
Lochan an Tairbh	Medium	Moderate	In addition to the provision of appropriate construction and operation-stage drainage, an exclusion zone will be established during the construction period for the watercourse diversions and carriageway works in the vicinity of Lochan an Tairbh as shown in Environmental Mitigation Drawing 6.6 (Volume 3) , to restrict construction and permanent works activities to only what is necessary for the establishment of the pre-earthworks drainage, watercourse diversions and the carriageway in the vicinity. The Contractor will also minimise disturbance of the natural soil profile and landform in the vicinity as far as is practicable and re-instate work areas that are utilised, while adopting appropriate working methods to avoid impacts on water quality and sediments in the lochan (Mitigation Item P09-G3). With these measures, potential impacts in the area would be expected to reduce to be of Neutral/ Slight significance.	Neutral/ Slight
Rock Exposures	Negligible	Slight	Loss of existing rock exposures has the potential to be off-set by the provision of new ones in areas of widening and cutting identified as being likely to intercept bedrock. The extent of this will be determined during the detailed design and a requirement will be placed on the Contractor for a suitably qualified and experienced engineering geologist to be on site while rock is cut for the Proposed Scheme, to conduct logging and inspections, and to ensure rock cuts are profiled to be as natural as possible and to minimise visible engineered elements (Mitigation Item P09-G2). With these measures, residual impacts would be expected to reduce to be of Neutral/ Slight significance.	Neutral/ Slight
Soils				
Soil Conservation	Medium	Slight/ Moderate	The establishment of a Soil Management Plan (Mitigation Item P09-G4) for implementation during construction combined with measures in relation to agricultural land/ soils (Mitigation Item SMC-CP8 and SMC-CP9 (Chapter 8)) and materials management (Mitigation Items SMC-G9 and SMC-M3 (Chapter 18)) will ensure that soil resources, soils of conservation interest or low to medium agricultural productivity are excavated, managed, re-used and re-instated sustainably and appropriately; with residual impacts of Neutral/ Slight and Neutral to Neutral/ Slight significance anticipated, respectively.	Neutral/ Slight
Agricultural Soil Productivity	Low to Medium	Neutral/ Slight to Slight/ Moderate	It would also be expected that the Soil Management Plan will be linked directly to agricultural land management aspects, as well as landscape, ecology and peat mitigation proposals regarding habitat re-instatement, restoration and creation, as outlined in Appendix 6.1, Appendix 6.2, Appendix 10.6 and Appendix 12.3 (Volume 2) , and illustrated in Environmental Mitigation Drawings 6.1 to 6.12 (Volume 3) . In this respect, it is recognised that the soil-base for certain habitats in these (i.e. dry heath, wet heath/ bog, acid grassland, wet grassland, woodlands and wetlands) will be important.	Neutral to Neutral/ Slight
Peat	Negligible to High	Neutral to Moderate	The unnecessary disturbance of peaty soils and peat has been reduced through design development as far as is practicable. The OPMP in Appendix 10.6 (Volume 2) demonstrates ways in which peaty soils and peat that must be excavated can be beneficially re-used as part of the Proposed Scheme for landscape restoration and habitat re-instatement, or re-use in selected SuDS basins and compensatory flood storage areas, which offer opportunities for the extent of peat and wetland habitats in the locality to be maintained where suitable and practicable. This will be subject to refinement by the Contractor and agreement in consultation with SEPA, SNH and CNPA. However, together with construction methods to further avoid or reduce impacts where possible (Mitigation Items P09-G7), and other mitigation and monitoring related to peat stability, dewatering and re-instatement (Mitigation Items P09-G5 to P09-G12 and P09-G17), residual impacts are expected to reduce to be of Neutral to Slight/ Moderate significance in the short and medium-term, and are anticipated to reduce further in the longer-term, once ecological benefits from landscape restoration, habitat re-instatement and peat re-use become firmly established.	Neutral to Slight/ Moderate

Receptor	Sensitivity	Pre-Mitigation Impact Significance	Mitigation	Post-Mitigation Residual Impact Significance
Groundwater				
Groundwater Levels and Flow	Low to High	Slight to Moderate/ Large	Mitigation for potential impacts on groundwater levels and flow includes provision of appropriate construction and operation-stage drainage, combined with control measures and monitoring prior to, during and following construction (Mitigation Items P09-G13 to P09-G20). Optimising the drainage design and adoption of these measures will reduce impacts in the majority of instances. Residual impacts of between Neutral and Slight significance are expected on groundwater levels and flow in bedrock and Neutral to Slight/ Moderate, but locally Moderate to Moderate/ Large significance in the vicinity of some larger widenings and cuttings (P9-NJ-02, P9-MC-06, P9-MC-07, P9-MC-19 and P9-MC-22) in superficial deposits of medium and high sensitivity.	Neutral to Moderate/ Large
Groundwater Quality	Medium to High	Moderate to Very Large	Residual impacts with regards impacts on groundwater quality are expected to reduce to Neutral to Slight during construction and Neutral during operation due to pollution prevention mitigation (Mitigation Items SMC-W3 to SMC-W6 to SMC-W10 in Chapter 11); including adherence to SEPA Pollution Prevention Guidelines and otherwise, appropriate construction and operation-stage drainage. These would mitigate pollution risks to groundwater and associated receptors such as GWDTE, reducing the potential for pollutant release, preventing run-off from entering groundwater and controlling sediments/ discharges.	Neutral to Slight
Groundwater Dependent Terrestrial Ecosystems	Medium to Very High	Neutral to Very Large	<p>Embedded mitigation has reduced encroachment into notable habitats such as GWDTE where practicable, but the Proposed Scheme could result in the direct loss/ disturbance of individual areas comprising 6.94 ha of wet woodland, 14.19 ha of wet grassland, 0.44 ha of seepages/ flushes/ springs, 0.41 ha of fen and swamp, 2.18 ha of wet heath and 2.54 ha of bog, due to the infrastructure footprint and wider land made available. Approximately 4.50 ha of these areas correspond to habitats that represent or contain components of either the floodplain mire or plant assemblage interest features of the River Spey – Insh Marshes Ramsar, SSSI and/ or Insh Marshes NNR, principally around the River Spey bridge crossing, and 0.01 ha corresponds to an area of transition mire/ quaking bog, which is a qualifying interest feature of the Insh Marshes SAC.</p> <p>The landscape and ecological mitigation shown in Environmental Mitigation Drawings 6.1 to 6.12 (Volume 3) outline measures and areas to re-instate or restore GWDTE habitat types such as wet heath, wet grasslands and wet woodland in the study area, while the Outline Habitat Management Plan in Appendix 12.13 (Volume 2) provides a basis for additional specific wetland re-instatement, restoration and management measures in relation to habitat and interest features of the River Spey – Insh Marshes Ramsar, SPA and SSSI, Insh Marshes SAC and Insh Marshes NNR to be established. Mitigation Item P09-E25 in Chapter 12 as detailed in Appendix 6.2 (Volume 2), also sets out a commitment to create approximately 36ha of water habitat (including wet grasslands, marshy grasslands and other riparian habitat enhancements) at the Dellmore of Kingussie prior to construction. These proposals are therefore anticipated to provide compensation for the majority of habitat loss and disturbances, including those within designated sites, together with re-instatement and restoration of areas affected in the permanent works boundaries and land made available following construction (Mitigation Items P09-G9 and P09-G10). The OPMP in Appendix 10.6 (Volume 2) also outlines opportunities for the potential creation of peat and wetland habitats in selected SuDS basins and compensatory flood storage areas where suitable and practicable (Mitigation Item P09-G5).</p> <p>Additional detailed assessment will be undertaken for areas of widening, cutting or other works anticipated to result in indirect impacts on GWDTE prior to construction. Based on this, groundwater exclusion, containment or other control measures will be considered and implemented during construction and operation to reduce indirect effects and to maintain or facilitate groundwater through-flows where necessary. This will be supplemented by measures in relation to the control of sediments, run-off, discharges and pollution prevention (Mitigation Items SMC-W3 and SMC-W6 to SMC-W8 in Chapter 11), with specific monitoring and mitigation plans (Mitigation Items P09-G14 and P09-G19), ecological site supervision and additional micro-siting during detailed design and construction also recommended (Mitigation Item P09-G20).</p> <p>At this stage following the implementation of mitigation, residual impacts on individual habitat areas are expected to be variable, between Slight and Very Large significance due to partial or complete loss in the Proposed Scheme footprint or disturbance in the wider land made available, but the majority of these are anticipated to be off-set or reduce in the longer-term, once measures for habitat compensation, re-instatement and restoration become firmly established. Residual indirect effects on some individual areas may vary between Neutral and Slight/ Moderate significance.</p>	Neutral to Very Large

Receptor	Sensitivity	Pre-Mitigation Impact Significance	Mitigation	Post-Mitigation Residual Impact Significance
Groundwater Effects on Surface Water	Low to Very High	Neutral to Moderate/ Large	<p>Groundwater intercepted via road cuttings and widenings will be returned to the same down-gradient catchments during the operational phase through appropriate drainage design, and the diversion or retention of existing drainage channels and watercourse crossings. This is expected to compensate for localised losses of or alterations in groundwater baseflow to surface water features at the catchment scale, but measurable residual impacts of Slight to Slight/ Moderate significance on baseflow to some features may remain at the local scale.</p> <p>Additional detailed assessment prior to construction will also be undertaken of the widenings and cuttings predicted to result in groundwater-related impacts on surface water features. Based on this, additional mitigation measures will be put in place where necessary, such as re-directing abstracted groundwater to the surface water receptor or the relevant catchment (Mitigation Item P09-G14).</p>	Neutral to Slight/ Moderate
Groundwater Abstractions and Private Water Supplies				
Nuide Farm (ABS 9.6a and 9.6b)	High	Large/ Very Large	<p>If impacts to a PWS source and/ or network are confirmed following additional surveys, protective measures during construction to protect these shall be incorporated. If protection is not possible, alternative sources of water or replacement/ diverted networks shall be put in place with a specific monitoring plan and mitigation strategy developed for each supply (Mitigation Item P09-G21). With these measures, residual impacts on the PWS features at Nuide Farm (ABS 9.6a and ABS 9.6b), Inverton (ABS 9.8b), Ruthven Cottage and Knappach Cottage (ABS 9.9) and Balavil Estate, Lynchat Farm, East Lodge and Railway Cottage (ABS 9.13) would be expected to reduce to Neutral.</p>	Neutral
Inverton (ABS 9.8b)	High	Large/ Very Large		Neutral
Ruthven Cottage/ Knappach Cottage (ABS 9.9)	High	Large/ Very Large		Neutral
Balavil Estate (ABS 9.13)	High	Large/ Very Large		Neutral
Coulintyre Cottage (ABS 9.16)	High	Large/ Very Large	<p>While potential impacts to the PWS network associated with Coulintyre Cottage (ABS 9.16) are identified, the property it serves is physically located within the Proposed Scheme footprint and there is a possibility that it will be demolished. It is therefore assumed that the PWS and associated network will be abandoned by the time construction works take place. Combined with additional surveys to locate the extent of the source and network within the LMA, followed by decommissioning (Mitigation Item P09-G24), residual impacts are therefore assessed as Neutral.</p>	Neutral
Ruthven Farm (ABS 9.10) and Ruthven Steading (ABS 9.11)	High	Slight/ Moderate	<p>With specific monitoring and this informing potential additional corrective actions or provision of a temporary or long-term alternative source of water (Mitigation Item P09-G22), residual impacts on the PWS features at Ruthven Farm (ABS 9.10) and Ruthven Steadings (ABS 9.11) would be expected to reduce to Neutral.</p>	Neutral
Torra Dhaimh/ Ralia Café (PW 9.15)	High	Large/ Very Large	<p>Additional surveys shall be undertaken prior to construction, to confirm the location, status, depth and use of the possible well feature at Torra Dhaimh/ Ralia Café (PW 9.15) and any associated pipe network. If this remains to be utilised as a water source and significant impacts are confirmed, an alternative source of water or replacement/ diverted network shall be put in place (Mitigation Item P09-G23). Alternatively, the well will be decommissioned and residual impacts would be Neutral.</p>	Neutral

Receptor	Sensitivity	Pre-Mitigation Impact Significance	Mitigation	Post-Mitigation Residual Impact Significance
Potential Contamination				
Potential Contamination Sources and Ground Gas	-	Very Low to Moderate	Following implementation of standard mitigation measures for the A9 Dualling Programme (Mitigation Items SMC-G1 to SMC-G14) in relation to potential contamination sources, residual direct and indirect impacts are expected to reduce to Low during construction and Very Low during operation.	Very Low to Low

Statement of Significance

- 10.6.3 With the Proposed Scheme in place and taking the identified mitigation into account, localised residual impacts of **Moderate** to **Moderate/ Large** significance are anticipated to remain on groundwater levels and flows within glacial, glaciofluvial and alluvial deposits during construction and operation in the vicinity of some larger areas of widening or cutting.
- 10.6.4 Appropriate construction techniques and work methods, control and design measures will be implemented together with the development of specific monitoring and mitigation plans to further reduce peat excavation and disturbance, as well as direct and indirect GWDTE habitat impacts during construction and operation; which will be supplemented with the establishment of compensatory landscape, peat re-use, and habitat re-instatement, restoration and creation measures both prior to and following construction. It is recognised that some individual areas of peat and GWDTE habitat may be subject to significant impacts of up to **Slight/ Moderate** and **Moderate** to **Very Large** significance, principally due to direct loss within the Proposed Scheme footprint or disturbance in the wider land made available, and that this includes some areas that correspond to or contain components of environmental designation interest features. However, taking the overall scale of the Proposed Scheme and impacts into account, and with the provision of mitigation, specific monitoring and compensation measures; the residual impacts in relation to these are expected to be off-set and reduce in the longer-term, and no significant ecological losses are anticipated overall.
- 10.6.5 These potential impacts have additionally been considered in the context of ecological and other effects on the River Spey – Insh Marshes Ramsar, SPA and SSSI, Insh Marshes SAC and NNR and River Spey SAC; within **Chapter 11**, **Chapter 12** and the Habitats Regulations Appraisal, where relevant. Collectively and following the implementation of mitigation, it has been determined that there would be no adverse effects on the integrity of these designated sites as a result of the Proposed Scheme during construction or operation.
- 10.6.6 All other residual impacts on geology, soils and groundwater receptors are not predicted to be significant in the context of the EIA regulations.

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