13. Groundwater

13.1 Introduction

13.1.1 This chapter of the Environmental Statement (ES) assesses the likely significant effects of the Proposed Development with reference to groundwater. The chapter should be read in conjunction with **Chapter 2: Description of the Proposed Development** and with reference to relevant parts of other chapters including **Chapter 12: Surface Water and Flood Risk** and **Chapter 10: Land Quality**, where common receptors have been considered and where there is an overlap or relationship between the assessment of effects.

13.2 Limitations of this assessment

13.2.1 No limitations relating to groundwater have been identified that affect the robustness of the assessment of the likely significant effects of the Proposed Development.

13.3 Relevant legislation, planning policy and technical guidance

Legislative context

13.3.1 The following legislation is relevant to groundwater and the assessment presented within this chapter:

- The EU *Water Framework Directive (2000/60/EC)*[1] (WFD), as enacted into domestic law by the *Water Environment (Water Framework Directive) (England and Wales) Regulations 2003*[2]: focuses on delivering an integrated approach to the protection and sustainable use of the water environment on a river basin scale;
- *Environmental Permitting (England and Wales) Regulations 2010 (SI 2010 No. 676)*[3], as amended includes requirements for the prevention of hazardous substances entering groundwater and the control of non-hazardous pollutants to avoid pollution of groundwater. Discharges to groundwater are controlled by these regulations;
- *Water Resources Act 1991*[4]: states that it is an offence to cause or knowingly permit polluting, noxious, poisonous or any solid waste matter to enter controlled waters. The Act was revised by the *Water Act 2003*[5], which sets out regulatory controls for water abstraction, discharge to water bodies, water impoundment and protection of water resources;
- The *Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015*[6]: sets out standards for surface water quality;

[1] The EU Water Framework Directive (2000/60/EC), [online]. Available at: https://eur-lex.europa.eu/resource.html?uri=cellar:5c835afb-2ec6-4577-bdf8-756d3d694eeb.0004.02/DOC_1&format=PDF [Checked 21/08/2018].
[2] The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003, [online]. Available at: http://www.legislation.gov.uk/uksi/2003/3242/contents/made [Checked 01/08/2018].
[3] The Environmental Permitting (England and Wales) Regulations 2016 together with subsequent amendments, [online]. Available at: https://www.legislation.gov.uk/uksi/2016/1154/pdfs/uksi_20161154_en.pdf [Checked 01/08/2018].
[4] Water Resources Act 1991, [online]. Available at: https://www.legislation.gov.uk/ukpga/1991/57/contents [Checked 01/08/2018].
[5] The Water Act 2003, [online]. Available at: https://www.legislation.gov.uk/ukpga/2003/37/contents [Checked 21/08/2018].
[6] The Water Framework Directive (Standards and Classification) Directions (England and Wales) (2015), [online]. Available at: http://www.legislation.gov.uk/uksi/2015/1623/pdfs/uksiod_20151623_en_auto.pdf [Checked 01/08/2018].

- *Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (SI No 571)* (hereafter referred to as the 'EIA Regulations');
- *Environment Act 1995*[7]; and
- *Environmental Protection Act 1990*[8].

Planning policy context

13.3.2 There are a number of policies and guidance documents at the national and local level that are relevant to the Bristol Airport Limited (BAL) ES. In addition to policy referenced in **Chapter 5: Legislative and Policy Overview**, policy directly applicable to Groundwater is listed in **Table 13.1**.

Table 13.1 Relevant policies and their implications for Groundwater

Policy reference	Implications
National Planning Policy Framework (NPPF) 2018[9]	
Paragraph 148	Considers the need for local planning authorities to mitigate and adapt to climate change, taking full account of flood risk and water supply and demand considerations.
Paragraph 178	Requires decisions to take account of the suitability of the site for its proposed use, taking account of ground conditions, land stability and contamination.
NPPF Planning Practice Guidance[10]	
Land affected by contamination	See **Chapter 10: Land Quality**
Water supply, wastewater and water quality	Advises on how planning can ensure water quality and the delivery of adequate water and wastewater infrastructure. In particular for groundwater it identifies: The need to consider how to help protect and enhance local surface water and groundwater in ways that allow new development to proceed. For example, it can steer potentially polluting development away from the most sensitive areas, particularly those in the vicinity of potable water supplies (designated Source Protection Zones (SPZ) or near surface water, drinking water abstractions); and The need to consider the type or location of new development where an assessment of the potential impacts on water bodies may be required. It also notes that there may be situations in which particular types of sustainable drainage systems (SuDS) may not be practicable.
North Somerset Council Core Strategy January 2017[11]	
CS2 – Delivering sustainable design and construction	Requires the application of best practice to incorporate SuDS to manage runoff from new development. These should be integrated into designs and easily maintained.
CS3 – Environmental impacts and flood risk management	This states that: "*development that, on its own or cumulatively, would result in air, water or other environmental pollution or harm to amenity, health or safety will only be permitted if the potential adverse effects would be mitigated to an acceptable level by other control regimes, or by measures included in the proposals, by the imposition of planning conditions or through a planning obligation*". It also states that: "*Development that, in the opinion of the council after consultation with the Environment Agency (EA), poses an unacceptable risk of pollution of or damage to the water*

[7] Environment Act 1995, [online]. Available at: https://www.legislation.gov.uk/ukpga/1995/25/contents [Checked 21/08/2018].
[8] Environmental Protection Act 1990, [online]. Available at: https://www.legislation.gov.uk/ukpga/1990/43/contents [Checked 21/08/2018].
[9] Ministry of Housing, Communities and Local Government (2018). National Planning Policy Framework, [online]. Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2 [Checked 12/08/2018].
[10] Ministry of Housing, Communities and Local Government (2018). National Planning Policy Framework Planning Practice Guidance, [online]. Available at: https://www.gov.uk/government/collections/planning-practice-guidance [Checked 28/08/2018].
[11] North Somerset Council (2017). Core Strategy, [online]. Available at: https://www.n-somerset.gov.uk/wp-content/uploads/2015/11/Core-Strategy-adopted-version.pdf [Checked 16/04/18].

Policy reference	Implications
	environment either directly or via the surface water sewerage system, or which does not dispose of surface water run-off in an acceptable manner, will only be permitted if these concerns can be overcome."
North Somerset Council Development Management Policies Sites and Policies Plan Part 1[12]	
DM1 - Flooding and drainage	This policy aims to discourage inappropriate development in flood risk areas and to ensure that the impact of new development on flooding is fully taken into account. In particular for groundwater it states that "*Open areas, including highways, within developments must be designed to optimise drainage and reduce run-off, while protecting groundwater and surface water resources and quality."*

Technical guidance

13.3.3 **Table 13.2** lists guidance documents which are relevant to the assessment of the effects on Groundwater.

Table 13.2 Technical guidance relevant to Groundwater

Guidance	Relevance
Approach to Groundwater Protection[13]	Provides a set of EA position statements that describe their approach to managing and protecting groundwater. It is aimed at helping anyone whose proposed activities will have an impact on or be affected by groundwater. The EA use these position statements as a framework to make decisions on activities that could affect groundwater.
CIRIA C532: Control of water pollution from construction sites[14]	This document provides help on environmental good practice for the control of water pollution arising from construction activities. It focuses on the potential sources of water pollution from within construction sites and the effective methods of preventing its occurrence.
CIRIA C736: Containment systems for the prevention of pollution[15]	This guidance aims to assist owners and operators of industrial and commercial facilities storing substances (inventories) that may be hazardous to the environment.
HSG176 Storage of Flammable liquids in tanks[16]	This guidance applies to above and below ground fixed bulk storage tanks. It applies to premises where flammable liquids are stored in individual tanks or groups of tanks. It may also be applied to portable or skid-mounted vessels with capacities in excess of 1,000 litres. It gives guidance on the design, construction, operation and maintenance of installations used for the storage of flammable liquids in fixed and transportable tanks operating at or near atmospheric pressure.
Piling and Preventative Ground Improvement Methods on Land Affected by Contamination: Guidance on pollution prevention[17]	Provides guidance on assessing risks associated with, and preventing pollution from, piling and penetrative ground improvement methods on land affected by contamination.

[12] North Somerset Council (2016). Development Management Policies Sites and Policies Plan Part 1, [online]. Available at: http://www.n-somerset.gov.uk/wp-content/uploads/2015/11/Sites-and-Policies-Plan-Part-1-Development-Management-Policies-July-2016.pdf [Checked 01/08/2018].
[13] Environment Agency (2018). Groundwater protection position statements, [online]. Available at: https://www.gov.uk/government/publications/groundwater-protection-position-statements [Checked 28/08/2018].
[14] CIRIA (2001). Control of water pollution from construction sites. Guidance for consultants and contractors (C532).
[15] CIRIA (2014). Containment systems for the prevention of pollution Secondary, tertiary and other measures for industrial and commercial premises (C736).
[16] Health & Safety Executive (2015). The storage of flammable liquids in tanks. HSG176 (Second edition).
[17] Environment Agency (2001). Piling and Penetrative Ground Improvement Methods on Land Affected by

Guidance	Relevance
CIRIA C962: Environmental good practice on site [18]	This guidance provides advice on managing construction on site to minimise environmental impacts.

13.4 Data gathering methodology

13.4.1 The EIA has been undertaken for the Proposed Development, as described in **Chapter 2: Description of the Proposed Development** and used the sources of information set out in **Table 13.3**.

Table 13.3 Sources of information

Topic	Aspect	Source of information
Topography and land-use	Ground elevation and gradient	Ordnance Survey (OS) 1:50,000, Landranger Sheet 182 Weston-super-Mare OS 1:50,000, Landranger Sheet 172 Bristol & Bath OS 1:25,000, Explorer Sheet 154 Bristol West & Portishead On-line maps and aerial photography[19]
Hydrology	River network and location of springs	OS 1:50,000, Landranger Sheet 182 Weston-super-Mare OS 1:50,000, Landranger Sheet 172 Bristol & Bath OS 1:25,000, Explorer Sheet 154 Bristol West & Portishead On-line maps and aerial photography[19] Department of Environment, Food and Rural Affairs MAGIC database[20]
Geology	Solid and drift geology	British Geological Survey (BGS) 1:50,000 Series Geology maps. British Geological Survey, 2004. Sheet 264, Bristol, Solid and Drift Edition BGS Geology of Britain Viewer[21]
Hydrogeology	Aquifer type	Groundwater SPZs[20]
	Groundwater flow direction or groundwater level	BAL groundwater monitoring data Hydrogeology of Bristol International Airport: Desk Study[22]
	Water Abstractions and discharges	Landmark Envirocheck report, June 2017
	Groundwater quality (Water Framework Directive (WFD) information)	Environment Agency River Basin Management Plan (2016 cycle 2) information, via the Environment Agency Catchment Data Explorer[23]
	Groundwater abstractions and discharges	Information has been obtained from the Landmark Envirocheck report, June 2017, and checked against records held by the EA (licensed abstractions and discharge) and NSC (private water supplies).

Contamination: Guidance on Pollution Prevention. NC/99/73.
[18] CIRIA (2015). Environmental good practice on site guide (fourth edition) (C741).
[19] On-line maps and aerial photography, [online]. Available at: https://www.bing.com/maps [Checked 21/08/2018].
[20] Defra (2018). MAGIC database, [online]. Available at: http://magic.defra.gov.uk/ [Checked 21/08/2018].
[21] British Geological Survey (2018). British Geological Survey Geology of Britain Viewer, [online]. Available at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html [Checked 21/08/2018].
[22] AEA Technology (2000). Hydrogeology of Bristol International Airport: Desk Study. AEAT/ENV/R/0447.
[23] Environment Agency (2018). Environment Agency Catchment Data Explorer, [online]. Available at: http://environment.data.gov.uk/catchment-planning/ [Checked 21/08/2018].

Topic	Aspect	Source of information
	Hydrogeology of Bristol Airport	AEA Technology, 2000, Hydrogeology of Bristol International Airport: Desk Study. AEAT/ENV/R/0447

Study area

13.4.2 The hydrogeological 'zone of influence' (ZoI) has been defined as the Principal Aquifer which lies in part beneath the application site (refer to **Figure 13.1**) and forms the Bristol Airport Carboniferous Limestone groundwater body. It includes the area beneath the application site and extends westwards to Bristol Water's groundwater abstraction at Chelvey. The Bristol Airport Carboniferous Limestone groundwater body effectively defines the potential ZoI, linking sources within the application site via flow pathways, to potential receptors situated down gradient and off-site. A small part of the eastern part of the application site lies outside the SPZ.

13.4.3 For the purposes of the assessment, a 3km radius has been used to identify groundwater abstractions, springs and discharges to ground. This search radius captures nearly all of the Bristol Airport Carboniferous Limestone groundwater ZoI. The exception is a small area north-east of the application site since the distance between point entries of pollution and receptor is such that concentrations and quantities would be much reduced by the time they reach this receptor.

Desk study

13.4.4 The desk study has largely used published information combined with previous work by BAL. In addition, data has been obtained from the following organisations:

- EA:
  - Licensed abstractions and permitted discharges; and
- NSC:
  - Location of private water supplies.

Survey work

13.4.5 BAL has a groundwater monitoring programme that routinely surveys groundwater quality beneath the application site and the results of this programme have been used to inform this chapter. No additional groundwater survey work has been undertaken to inform this assessment as the data collected by this programme is sufficient for the purposes of this assessment.

13.5 Overall baseline

Current baseline

13.5.1 The topography, land use and hydrology baseline are the same as outlined in **Chapter 12: Surface Water and Flood Risk,** specifically **Section 12.5**.

Geology - solid and drift geology

13.5.2 The BGS geological map[21] identifies the application site and surrounding area as largely underlain by the Black Rock Limestone Subgroup. The exception is an area in the south associated with the Silver Zone Car Park and Bristol and Wessex Aeroplane Club, and also to the very north-west,

covering the north of Tall Pines Golf Club, where the bedrock geology is the Brockley Down Limestone. There is also a small area in the south-west of the application site where the Westbury Formation and Cotham Member (undifferentiated) are present.

13.5.3 The Black Rock Limestone is of Carboniferous Age. It is a thin to thick-bedded packstone with subordinate thin beds of shaley argillaceous packstone and mudstone. The Westbury Formation and Cotham Member consists of interbedded mudstones and limestones.

13.5.4 The Carboniferous Limestone forms an outlier to the main outcrop of the Mendips and is in the form of a dome-shaped periclinal structure (sloping down in all directions from a central dome) from which the rocks dip away in a radial manner.

13.5.5 No superficial deposits are recorded as being present beneath the application site.

13.5.6 Borehole logs from investigations at the application site generally show a thin layer of Made Ground overlying silty drift deposits. The combined Made Ground and superficial deposits, typically extend to a depth of approximately 2m to 5m below ground level (bgl). The silty drift is locally deeper, up to 8m to 9m bgl in several of the boreholes, indicating the presence of infilled solution or mining features. At depth, boreholes have encountered a sequence of limestone, with layers of mudstone, which became more frequent towards the base of the sequence. Cavities and zones of poor recovery were noted at around 40m bgl in several boreholes.

13.5.7 BAL has recorded a number of contemporary subsidence features that have (typically) formed within the northside car park. These are considered to be associated with sinkholes or mining features in the underlying limestone.

Hydrogeology

13.5.8 The Black Rock Limestone Subgroup is a Principal Aquifer. Principal Aquifers are rocks that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

13.5.9 The Brockley Down Limestone is classified as a Secondary A Aquifer. These are predominantly lower permeability rocks (compared to Principal Aquifers) which may store or yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons or weathering.

13.5.10 The Westbury Formation and Cotham member (undifferentiated) is a Secondary B Aquifer.

13.5.11 The application site is in an area of High groundwater vulnerability and is considered to be an area where pollutants could be easily transmitted to groundwater. These areas are characterised by high leaching soils and the absence of low permeability superficial deposits.

13.5.12 The application site is in Zone 2 of a groundwater SPZ (with the exception of the eastern edge which lies beyond the zone boundary), as indicated in **Figure 13.1**. This SPZ is for Bristol Water's Chelvey source, which is approximately 3.4km to the north-east of the application site.

13.5.13 A second SPZ lies to the east of Bristol Airport and extends into the easternmost part of the application site, east of the A38. This has been defined for the surface water catchment to Bristol Water's Winford Brook source. The definition of the surface water catchment reflects the potential for rapid flow pathways to exist due to solution-enhanced weathering of the limestone (collectively known as Karst features) along which pollution migration could occur.

13.5.14 The major regional discharge for the Broadfield Down area is the large springs at Chelvey, which issue through fault-disturbed Mercia Mudstone and related conglomerate. The Chelvey Well intercepts a proportion of the water feeding the springs and can supply 27Ml/day. The discharge at Chelvey Well is estimated to account for approximately 40% of the recharge to the Carboniferous Limestone aquifer. Although there are no important water supply wells within 2km

of the application site, the presence of major springs like the Chelvey source on the north-western fringe of the plateau are testament to the importance of this aquifer as a source of potable water.

13.5.15 SPZs are shown on **Figure 13.1** while groundwater abstractions associated with Bristol Airport are shown on **Figure 13.2**. Groundwater flow within the SPZ is anticipated to be towards Chelvey.

13.5.16 The EA has defined SPZs (inner, outer and total catchment) for all groundwater sources such as springs, wells and boreholes used for public drinking water supply and for groundwater sources supplying some private water supplies and food processing factories. These zones identify areas at risk of contamination from surface activities that might cause pollution. An area of the aquifer under the application site has been defined as SPZ2 because it lies within the catchment to Chelvey Well. SPZ2, or the Outer Protection Zone, is the area where pollution may take up to 400 days to travel to the spring. The extent of the SPZ suggests that groundwater flow from beneath Bristol Airport is predominantly to the west, towards Chelvey. The exception to this is a small part of the application site to the east where groundwater flow is expected to be eastward. Existing Bristol Airport infrastructure within the SPZ includes the runway and terminal buildings.

13.5.17 Other springs in the area may also receive recharge from beneath the application site. These include Cold Bath Spring on the north flank of Broadfield Down at Barrow Gurney, and a number of springs to the east at the head of the Winford Brook in Winford (3km to the east). A number of springs also rise in the valley to the south at: Lye Cross (NGR 492 627) (2.2km); Sutton Lane (NGR 510, 623) (2.2km); an unnamed location (NGR 511, 623) (2.3km); and Pit's Farm (NGR 515 621) (2.6km). These feed into the headwaters of a number of small streams on the outcrop of the Mercia Mudstone.

13.5.18 Surface water features around Broadfield Down are shown on **Figure 13.2** and the main features described in **Table 13.4**.

Table 13.4 Surface water features fed by the aquifer underneath the application site

Surface watercourse	Groundwater component of flow
River Kenn	Headwaters fed by spring at Chelvey Well to the northwest of Broadfield Down. Discharge from Chelvey Well springs is thought to comprise 38% of recharge from Broadfield Down. The application site is located within SPZ2 (Outer Protection Zone) for this river and recharge from it has potential to contribute significantly to this flow.
Little River	Groundwater flow is considered to be predominantly flowing towards Chelvey therefore recharge from the application site is likely to contribute to the baseflow component of this river, as Little River is in the vicinity of Chelvey.
Land Yeo	Rises at Cold Bath Spring and Dundry Hill Spring to north of Broadfield Down. Discharge from Cold Bath Spring is estimated to comprise only 6% of Broadfield Down recharge. Therefore, it is unlikely that recharge from the application site contributes significantly to this flow.
River Chew	Tributaries of the River Chew drain the eastern flank of Broadfield Down. Groundwater flow beneath the application site is considered to be draining westwards towards Chelvey and is, therefore, unlikely to contribute significantly to this flow.
Winford Brook	Winford Brook rises in Winford approximately 3km to the east of the application site. Groundwater flow beneath the application site is considered to be predominantly draining to Chelvey and it is therefore unlikely that recharge from it contributes significantly to this flow.
Congresbury Yeo	Congresbury Yeo is approximately 5km to south of site and is fed by springs 3km to the south. Groundwater flow is considered to be predominantly draining towards Chelvey. It is, therefore, unlikely that recharge from the application site contributes significantly to this flow.

13.5.19 Groundwater lies at an elevation of approximately 145m Above Ordnance Datum (AOD), compared to ground levels of 163m AOD to 185m AOD.

Groundwater quality

13.5.20 The application site lies over the Bristol Airport Carboniferous Limestone groundwater body. The status of the water body is summarised in **Table 13.5**.

Table 13.5 Summary of WFD groundwater body status[24]

WFD Water Body	Groundwater body Bristol Airport- Carboniferous Limestone
Water Body Identifier	GB40901G804900
Overall current (2015 Cycle 2) status	Poor
Quantitative Saline Intrusion	Good
Chemical Drinking Water Protected Area	Good
Trend Assessment	No trend
Quantitative Status element	Poor
Quantitative GWDTEs test	Good
Quantitative Water Balance	Good
Objectives	Good

13.5.21 The overall 'Poor' status of the Bristol Airport Carboniferous Limestone groundwater body is driven by the quantitative status which is poor due to abstraction affecting natural flows. This is likely to be due to Bristol Water's abstractions for public water supply. BAL does not have any abstractions, and none are planned for the Proposed Development.

13.5.22 The Proposed Development is not within a surface water Nitrate Vulnerable Zone (NVZ), the nearest being a Eutrophic Water NVZ located approximately 1.35km to the south-east of the application site, however, this is not hydrologically linked.

13.5.23 A surface water Drinking Water Safeguard Zone (DWSZ) covers the far east of the application site and extends to the east covering the catchment of the Winford Brook upstream of Chew Magna Reservoir. The DWSZ incorporates measures to limit the entry of pesticides into surface water. BAL only uses a small quantity of herbicide on site to treat critical airfield areas such as runway edge lights and Instrument Landing Display (ILS) area markers as these pieces of infrastructure cannot be covered. From 7 March 2017 until 5 May 2018 on 900ml of glyphosate was used for this purpose. These areas, whilst using this product, is completed by trained, certificated, competent and experienced individuals whom are qualified to PA6 and PA2 (Knapsack) MTPC standards.

13.5.24 Water quality in the aquifer around the perimeter of Bristol Airport is monitored at quarterly intervals at seven boreholes. In addition, monitoring of groundwater at a historical spill in an area around the terminal building has been undertaken. The contamination was identified by a site investigation within the footprint of Bristol Airport's Eastern Terminal Extension (ETE) in 2014 and was associated with a transit shed that was demolished in the 1980s. This found hydrocarbon

[24] Environment Agency (2018). Catchment Data Explorer: catchment data search, [online]. Available at: http://environment.data.gov.uk/catchment-planning/ [Checked 28/08/2018].

contamination within the shallow, perched aquifer immediately underneath the ETE area. Following the discovery, BAL undertook further investigation and initiated a monitoring programme. The results of the monitoring programme were used to inform a Groundwater Risk Assessment (GWRA), which was published and subsequently findings agreed with the EA. The results of the monitoring have indicated the presence of hydrocarbons in the form of aliphatic and aromatic hydrocarbons in the spill area but contamination was absent in perimeter boreholes.

Groundwater abstractions and discharges

13.5.25 There are no surface water or potable (private water supply, PWS) abstractions within 2km of the application site. The application site lies in the SPZ for a public water supply borehole at Chelvey, some 3.5km to the north-west. This water supply is operated by Bristol Water.

13.5.26 There are seven discharge consents within 1km of the application site. These are predominantly drainage and trade effluent-site drainage for buildings at Bristol Airport. They include treated sewage disposal at two domestic properties and a Wessex Water Sewage Treatment Works. All discharges are into land via soakaways or infiltration systems.

13.5.27 The Winford Brook drains to Chew Magna reservoir, owned by Bristol Water. The reservoir is stocked for fishing. Water from here can be used as compensation flow to the downstream River Chew or pumped to Chew Valley Reservoir for water supply.

Future baseline

13.5.28 Few changes to the future baseline are predicted. There may be changes in the overall rate of infiltration to groundwater as a result of climate change. Current predictions (UKCP09) suggest that winters will be wetter and summers warmer and therefore drier. Bristol Water's[25] assessment of the impact of climate change on their Deployable Output (DO) is that there will be a small reduction by 2080. Climate change may also lead to more intense storms that have the potential to exceed the infiltration capacity of existing soakaways leading to surface water flooding. The climate trends projected for the operational phase of the Proposed Development are described in the Design and Access Statement (DAS).

13.6 Consultation

13.6.1 Consultation has been carried out with the EA and NSC. **Table 13.6** provides a summary of the issues about the Proposed Development that have been raised by consultees and the responses given. The issues raised by NSC and the EA are similar and hence the responses are similar in nature.

[25] Bristol Water (2018). Draft Water Resources Management Plan 2019, [online]. Available at: http://www.bristolwater.co.uk/about-us/environment/water-resources-plan-2019-update/ [Checked 21/08/2018].

Table 13.6 Summary of issues raised during consultation regarding groundwater

Issue raised	Consultee(s)	Response and how considered in this chapter	Section Ref
"NSC1. Despite there being no surface water courses close to the airport, streams at the edge of 'Broadfield Down' are maintained by groundwater base flow. Any development at the airport has the potential to impact on groundwater quality, which in turn could impact on surface waters. A statement to this effect should be included and the risk appropriately determined as part of the ES."	NSC	The risks to surface water have been considered in this ES. It is planned to use similar arrangements for drainage as those already used, i.e. infiltration to ground. Given the experience to date and the fact that this is an incremental increase, the risks are likely to be similar to the existing operation i.e. no change.	**Section 13.7 and paragraph 13.7.7**
"NSC2. In paragraphs 11.5.23 & 11.5.26 of the Scoping Report it is indicated that there are no private water supplies within 2km of the site. This should be substantiated and it should be clarified whether a water interest survey has been undertaken across the area to determine this. If it has not it cannot be assumed that there are no such interests. The Local Authority records should be checked as they will be complete and list all such sources."	NSC	Data requests were submitted to NSC (private wells) and the EA (licensed supplies). The results indicate that there are no private abstractions within 1km of the application site and no licenced abstractions within 2km of the application site. The nearest licenced abstraction is approximately 3km away.	**Section 13.5**
"NSC3. The ES should demonstrate that the proposed development is designed to reduce the risk from foul drainage. This may result in the need for further treatment to reduce the risk to groundwater body and associated receptors. The airport design and infrastructure should also be resilient to climate change. This might require the upgrade of soakaways, interceptor capacity etc. to reflect any changes in rainfall run-off etc."	NSC	Foul water drainage (sewerage) is not considered as this chapter primarily focuses on surface water run off to groundwater. The risks to groundwater have been assessed and the mitigation measures required considered. Mitigation is likely to be similar to existing operations as these have worked well to date and preserve the groundwater resource value of infiltration. The design capacity of new infrastructure will consider climate change allowances.	**Section 13.8**
"Please clarify the basis of there being no private water supplies within 2km. Has a water interest survey historically been undertaken across the area to determine this? If not, it cannot be assumed that there are no such interests. The Local Authority records should be checked as they will be complete and list all such sources. Where the risk associated with current and future activities justify, it, a Water Interest Survey should be undertaken to determine if such interests exist."	EA	Refer to response provided in NSC2. A desk-based water interest survey has been undertaken to identify water features within the ZoI. This has identified only a small number of features, which reflects the permeable nature of the ground across the Bristol Airport Groundwater Body and the great depth to groundwater. As a result, a full water interest survey has not been undertaken. Local Authority Records have been checked.	**Section 13.5**

Issue raised	Consultee(s)	Response and how considered in this chapter	Section Ref
"The airport should be designed so as to reduce the risk to water resources, where possible using sustainable urban drainage together with appropriate pollution prevention mechanisms such as appropriate designed interceptors etc."	EA	Refer to response provided in NSC1. The Bristol Airport surface water drainage system has been designed to reduce the risks to water resources through the use of sustainable drainage systems that infiltrate all surface water to ground. Pollution prevention measures, including the use of full-retention interceptors have been incorporated to prevent pollution of groundwater.	**Section 13.7**
"The airport should be designed so as to reduce the risk from foul drainage. This may result in the need for further treatment at nearby STW to reduce the risk to groundwater body and associated receptors."	EA	Refer to response provided in NSC3. The Bristol Airport surface water drainage system has been designed to reduce the risks to water resources through the use of sustainable drainage systems that infiltrate all surface water to ground. Pollution prevention measures, including the use of full-retention interceptors have been incorporated to prevent pollution of groundwater.	**Section 13.8**
"The airport design and infrastructure should be resilient to climate change. This may require the upgrade of soakaways, interceptor capacity etc. to reflect any changes in rainfall run-off etc."	EA	Appropriate climate change allowances have been incorporated in the design of new or modified components of the drainage design to serve the Proposed Development. However, where existing infrastructure is not being altered, no improvements of the associated drainage system are proposed on account of the difficulty of modifying systems at an operational airport. As investment in infrastructure at Bristol Airport is a continuous process, further opportunities may occur for adaptive improvements to these elements in response to future development proposals.	**Chapter 2: Description of the Proposed Development**

13.7 Scope of the assessment

13.7.1 This section outlines the following:

- Identification of potential receptors that could be affected by the Proposed Development; and
- The potential effects on identified receptors that could be caused by the Proposed Development. These are receptors for which there is a potential pathway that links the Proposed Development (the source) to the receptor.

13.7.2 The scope of assessment has been informed by:

- The Scoping Report (**Appendix 1A**);
- Scoping Opinion (**Appendix 1B**);
- The groundwater baseline (**Section 13.5**); and
- The Proposed Development design (**Chapter 2: Description of the Proposed Development**).

Spatial scope

13.7.3 The spatial scope of the assessment of Groundwater for the Proposed Development covers the application site, together with the ZoIs that have formed the basis of the study area as described in **Section 13.4**.

Temporal scope

13.7.4 The temporal scope of the assessment of Groundwater is consistent with the period over which the Proposed Development would be carried out and therefore covers the construction and operational periods (refer to **Chapter 2: Description of the Proposed Development**).

Potential receptors

Identification of receptors that could be subject to likely significant effects

13.7.5 Receptors have been identified from the conceptual site model (CSM) and the direction in which groundwater flows from beneath the application site towards receptors.

13.7.6 On the basis of the baseline appraisal, the following classes of receptors have been identified:

- Groundwater within the Principal Aquifer beneath and downgradient of the application site;
- Groundwater abstractions; and
- Surface water fed by groundwater baseflow via springs.

Likely significant effects

13.7.7 The effects of the Proposed Development on these receptors that have the potential to be significant are:

- Loss of water resources due to reduced infiltration recharge to ground from additional areas of hardstanding, leading to reduced water available to support spring flows and public water supply; and

- Contamination of groundwater beneath the application site leading to a requirement for treatment of public water supply (or loss of that supply) and degradation of water quality in springs.

13.7.8 The following is a list of the potential sources of contamination associated with the Proposed Development:

- Refuelling: Potential contaminants may include fuel or oil hydrocarbons (i.e. total petroleum hydrocarbons, polycyclic aromatic hydrocarbons, benzene, toluene, ethylbenzene and xylene);
- Airport operations: Potential contaminants may include de-icing chemicals, metals, fuel or oil hydrocarbons, surfactants, solvents, herbicides, organic and inorganic contaminants;
- Car parking and roadways: Potential contaminants may include metals and fuel or oil hydrocarbons; and
- Car valeting: Potential contaminants may include metals, solvents, detergents and fuel or oil hydrocarbons.

Receptors taken forward for assessment

13.7.9 The groundwater receptors that have been taken forward for assessment (scoped in) are summarised in **Table 13.7**.

13.7.10 Other receptors are considered too distant and/or not in potential hydraulic continuity (i.e. there is no 'pathway') from the application site.

13.7.11 **Table 13.7** also identifies receptors that have been scoped out from being subject to further assessment because the potential effects are not considered likely to be significant.

13.7.12 **Table 13.8** sets out the specific receptors identified for all three overarching groundwater receptors that are to be taken forward for assessment. Due to the nature of these receptors, it can be seen that there is an overlap with some receptors being both groundwater quality and groundwater resource receptors.

Table 13.7 Groundwater receptors scoped in / scoped out

Receptors	Scoped in / out	Basis
Groundwater in the Principal Aquifer beneath the site	In	Surface water from the application site will infiltrate to groundwater beneath the application site
Chelvey Springs Public Water Supply	In	The application site is within the SPZ for Chelvey indicating that groundwater from beneath the application site flows to Chelvey
Springs around the edge of Broadfield Down providing river baseflow	In	These springs are potentially fed by groundwater from beneath the application site
Public water supply from Chew Magna reservoir to the east	Out	Chew Magna is distant from the application site and is not downgradient of the application site. In addition, it is largely fed by surface water

Table 13.8 Groundwater receptors scoped in for further assessment

Receptors	Assessment criteria	Likely significant effects
Application site **Groundwater downgradient of the site** **Chelvey Springs Public Water Supply** **Other springs**	There is a requirement under the WFD (refer to **Section 13.3**) to achieve good quantitative status by ensuring a balance between the abstraction and recharge of groundwater.	The increase in areas of hardstanding (roofs, taxiways, aprons, and some carparks) as a result of the Proposed Development has the potential to reduce recharge to the aquifer resulting in a loss of groundwater resources affecting quantitative status.
Application site **Groundwater downgradient of the application site** **Chelvey Springs Public Water Supply** **Other springs**	The *Environmental Permitting Regulations 2016*[26] require that the entry of hazardous substances into groundwater is prevented and the entry of non-hazardous pollutants limited. To "prevent" an input into groundwater means: taking all measures deemed necessary and reasonable to avoid the entry of hazardous substances into groundwater and to avoid any significant increase in concentration in the groundwater, even at a local scale.	The unintentional or accidental release of pollutants or contaminants during construction and operation may lead to: the contamination of waterbodies used by Bristol Water for abstraction for water supply and/or pollution of springs or baseflow to surface water.

13.8 Environmental measures embedded into the development proposals

13.8.1 A range of environmental measures have been embedded into the Proposed Development as outlined in **Chapter 2: Description of the Proposed Development**, specifically **Section 2.5**. **Table 13.9** details how these embedded measures have influenced the groundwater assessment. Existing mitigation measures are controlled via Environmental Permits from the EA and discharge consents from Wessex Water. Future discharges to ground will also be subject to the same controls.

Table 13.9 Summary of the embedded environmental measures

Receptors	Changes and effects	Embedded measures
Groundwater beneath the application site **Groundwater downgradient of the application site** **Chelvey Springs Public Water Supply** **Other springs**	Construction phase: Uncontrolled sediment from the construction process entering the freshwater environment as a potential pollutant.	Embedded measures will be included in a Construction Environment Management Plan (CEMP) (**Appendix 2B**). Site access points will be regularly cleaned to prevent build-up of dust and mud. Earth movement will be controlled to reduce the risk of silt combining with the site run-off. Properly contained wheel wash facilities will be used (where required) to isolate sediment rich run-off. Cut-off ditches and/or geotextile silt-fences will be installed around excavations, exposed ground and stockpiles to prevent the uncontrolled release of sediments from the application site. Sediment traps will be required on all surface water drains in the surrounding region. Silty water abstracted during excavations will be discharged to settlement tanks or siltbusters as appropriate. Only clean run-off will be permitted to discharge to ground. A temporary discharge consent

[26] Environmental Permitting (England and Wales) Regulations 2016, SI 1154, [online]. Available at: http://www.legislation.gov.uk/uksi/2016/1154/made [Checked 13/11/2018].

Receptors	Changes and effects	Embedded measures
		will be agreed with EA prior to the commencement of works, if necessary.
Groundwater beneath the application site **Groundwater downgradient of the application site** **Chelvey Springs Public Water Supply** **Other springs**	Construction phase: Spillages of oils and other chemicals associated with the construction process entering groundwater as a potential pollutant.	Wherever possible, plant and machinery will have drip trays beneath oil tanks, engines, gearboxes or hydraulics which will be checked and emptied regularly and correctly disposed of via a licensed waste disposal operator. Oils and hydrocarbons will be stored in designated locations with specific measures to prevent leakage and release of their contents, including the sitting of the storage area away from the drainage system on an impermeable base, with an impermeable bund that has no outflow and is of adequate capacity to contain 110% of the contents. Valves and trigger guns will be protected from vandalism and kept locked when not in use. A spillage Environmental Response Plan will be produced as part of an overarching CEMP (**Appendix 2B**) and disseminated to relevant site employees with associated training. On-site provisions will be made to contain a serious spill or leak through the use of spill kits, booms, bunding and absorbent material.
Groundwater beneath the application site **Groundwater downgradient of the application site** **Chelvey Springs Public Water Supply** **Other springs**	Additional hard surfaces including new buildings, aprons, taxiways, carparks, yards and roads will reduce direct infiltration of rainfall recharge to the ground. This has the potential to reduce the volume of water entering the ground and hence to reduce the groundwater resource available. Reduced groundwater resources could affect the operation of the public water supply well at Chelvey and reduce baseflow to local rivers.	All runoff from hardstanding (roofs, taxiways, aprons, and some carparks) will be directed to soakaways. The Silver Zone Car Park Extension (Phase 2) will use the same Netpave permeable pavement system that has been successfully used in the existing Silver Zone Car Park Extension (Phase 1). This system allows infiltration to ground to continue. Netpave[27] permeable surfacing consists of stone surfacing contained within a hollow interlocking casing. The permeable stone surfacing allows the runoff to infiltrate into the lower sub base layers of the pavement before draining laterally into gravel-filled infiltration trenches. These measures will prevent loss of water resources.
Groundwater beneath the application site **Groundwater downgradient of the application site** **Chelvey Springs Public Water Supply** **Other springs**	Activities on the areas of hardstanding will involve the use of potentially polluting materials, principally in the form of fuel oils. Spills or leaks of these materials from tanks, tankers, vehicles and aeroplanes have the potential to pollute groundwater beneath the site by flowing into groundwater discharge points. New areas of parking to the south of the application site will be on areas of permeable paving. Leaks and spills here have the potential to discharge directly to groundwater. Pollution of groundwater could affect the operation of Chelvey Well and also pollute local rivers via baseflow.	All surface water drainage will be in sealed drainage systems that direct water to treatment. Oil water separators and anti-pollution control valves would be installed to control, retain and treat runoff before entry into the ground. An Emergency Plan will be developed as part of an overarching CEMP (**Appendix 2B**). Handling of potentially polluting material will be subject to controls to prevent leaks and spills. All runoff passing through soakaways will be treated by passing through full retention oil water separators before infiltrating to ground to limit the potential for pollution of groundwater resources.

[27] An example of this is provided at: https://www.bristol.gov.uk/documents/20182/34524/WoE+SuDS+Case+Study+05+-+Bristol+Airport+carpark+SuDS.pdf/0053a9b0-d14f-4ca7-b019-7476beedce1a [Checked 05/10/18].

Receptors	Changes and effects	Embedded measures
		In areas of permeable paving, the pollution potential is lower (only parked cars). The attenuation capacity of the soil or unsaturated zone is retained and will act to reduce the impact on groundwater. The thick unsaturated zone beneath the application site means that travel times will be long allowing time for attenuation. All potential contaminants will be adequately stored and monitored with minimised use and on-site storage of chemicals. All operational staff will be made aware of pollution responsibilities and be adequately trained. Continued monitoring will be used to demonstrate that groundwater is unaffected by the Proposed Development and to provide early warning of potential pollution.

13.9 Assessment methodology

13.9.1 The generic project-wide approach to the assessment methodology is set out in **Chapter 4: Approach to Preparing the Environmental Statement,** and specifically in **Sections 4.5** to **4.7**. However, whilst this has informed the approach that has been used in this groundwater assessment, it is necessary to set out how this methodology has been applied, and adapted as appropriate, to address the specific needs of this groundwater assessment.

Significance evaluation methodology

13.9.2 The EIA Regulations recognise that developments will affect different environmental elements to differing degrees, and that not all of these are of sufficient concern to warrant detailed investigation or assessment through the EIA process. The EIA Regulations require detailed assessment only of resources that are "likely to be *significantly affected* by the development".

13.9.3 The EIA Regulations themselves do not define significance and it is therefore necessary to state how this will be established for the specific circumstances of the Proposed Development. The significance of an effect resulting from a development (during construction or operation) is commonly assessed with reference to the sensitivity (or value) of a given receptor and the magnitude of the change as a result of the Proposed Development. This approach provides a mechanism for identifying areas where mitigation measures may be required and to identify the most appropriate measures to alleviate the risk presented by the Proposed Development, which will be adopted for the application site groundwater assessment. The residual effects of the Proposed Development on the groundwater environment will be evaluated assuming that identified mitigations are fully implemented.

13.9.4 In terms of the groundwater environment, the EIA is largely based on professional judgement, based on experience and the use of best practice guidance such as that published by CIRIA and Department for Environment, Farming and Rural Affairs (Defra). The key determinants of sensitivity and magnitude of change will relate to the Aquatic Environment and Water Resources.

13.9.5 **Table 13.10** details the basis for assessing receptor sensitivity.

Table 13.10 Establishing the sensitivity of receptors

Sensitivity	Criteria	Receptor type	Examples
Very High	Feature with a high quality and rarity at an international scale, with little potential for substitution	Groundwater quality	Conditions supporting groundwater fed (Groundwater dependent terrestrial ecosystems – GWTDE) sites with international conservation designations (Special Area of Conservation (SACs), Special Protection Areas (SPAs), Ramsar sites), where the designation is based specifically on water (or water dependent) features.
		Water resources	Regionally important public water supplies.
High	Feature with a high yield and/or quality and rarity at a national scale, with a limited potential for substitution	Water environment	Conditions supporting GWTDE sites with national conservation designations (i.e. Site of Special Scientific Interest (SSSI), National Nature Reserves (NNR)) where the designation is based on water (or water dependent) features. Receptor groundwater body (chemical and/or quantitative status) at least good status or potential.
		Water resources	Locally important public water supplies
Medium	Feature with a medium yield and/or quality at a regional scale or good quality at a local scale, with some potential for substitution	Water environment	GWDTEs with local conservation designations where the designation is based on water features. Receptor groundwater body (chemical and/or quantitative status) at least moderate status or potential.
		Water resources	Un-licensed potable private domestic water supplies.
Low	Feature with a low yield and/or quality at a local scale, with some potential for substitution	Water environment	Receptor groundwater body at less than moderate status or potential. Small groundwater fed watercourses not classified as a WFD water body.
		Water resources	Licensed abstractions which are not public water supply, e.g. industrial process water, spray irrigation.
Very low	Feature with minimal yield and/or very low quality at a local scale, with a high potential for substitution	Water environment	Receptor groundwater body at poor status or potential. Minor water features such as ditches, not classified as a WFD river water body.
		Water resources	Un-licensed non-potable abstractions, e.g. livestock supplies.

Magnitude of change

13.9.6 **Table 13.11** details the basis for assessing magnitude of change.

Table 13.11 Establishing the magnitude of change

Magnitude	Criteria	Receptor type	Examples of negative change
Very high	Results in major change to feature, of sufficient magnitude to affect its use or integrity	Water environment	Deterioration of groundwater quantity leading to sustained, permanent or long-term breach downgrading of WFD status.

Magnitude	Criteria	Receptor type	Examples of negative change
		Water resources	Complete loss of resource or severely reduced resource availability and/or quality, permanently compromising the ability of water users to exercise licensed rights.
High	Results in noticeable change to feature, of sufficient magnitude to affect its use or integrity in some circumstances	Water environment	Deterioration groundwater quality, leading to periodic, short-term and reversible breaches of relevant conservation objectives, or downgrading of WFD status (including downgrading of individual WFD supporting elements or ability to achieve future WFD objectives).
		Water resources	Moderate reduction in resource availability and/or quality, which may compromise the ability of water users to exercise licensed rights on a temporary basis or for limited periods.
Medium	Results in minor change to feature, with insufficient magnitude to affect its use or integrity in most circumstances	Water environment	Measurable deterioration in river flow regime, morphology or water quality, but remaining generally within conservation objectives, and with no change to WFD status (of overall status or supporting element status).
		Water resources	Minor reduction in resource availability and/or quality, but unlikely to affect the ability of water users to exercise licensed rights.
Low	Results in little change to feature, with insufficient magnitude to affect its use or integrity	Water environment	Limited measurable deterioration in river, GWTDE flow regime, or water quality and limited probability of consequences in terms of conservation objectives or WFD designations.
		Water resources	Limited measurable change in resource availability or quality and limited probability of changes to the ability of water users to exercise licensed rights.
Very low	Results in no change to feature, with insufficient magnitude to affect its use or integrity	Water environment	No measurable deterioration in river flow regime, morphology or water quality and no consequences in terms of conservation objectives or WFD designations.
		Water resources	No measurable change in resource availability or quality and no change in ability of water users to exercise licensed rights.

13.9.7 **Table 13.12** provides an indication of how the level of effect will be categorised from the interaction of a receptor's sensitivity and the magnitude of change. A level of effect of major/moderate or greater is of most importance to the decision-maker, and so these effects are generally considered significant. where a level of effect is minor or below, these are generally considered to be not significant.

Table 13.12 Establishing the level of effect

Sensitivity/importance/value	Magnitude of change: Very high	High	Medium	Low	Very low
Very high	Major (Significant)	Major (Significant)	Major (Significant)	Major (Significant)	Moderate (Probably significant)
High	Major (Significant)	Major (Significant)	Major (Significant)	Moderate (Probably significant)	Minor (Not significant)
Medium	Major (Significant)	Major (Significant)	Moderate (Probably significant)	Minor (Not significant)	Negligible (Not significant)
Low	Major (Significant)	Moderate (Probably significant)	Minor (Not significant)	Negligible (Not significant)	Negligible (Not significant)
Very low	Moderate (Probably significant)	Minor (Not significant)	Negligible (Not significant)	Negligible (Not significant)	Negligible (Not significant)

13.10 Assessment of Groundwater effects

Predicted effects and their significance

Receptor sensitivity

13.10.1 The aquifer beneath the application site is a **high** sensitivity receptor, as it is a Principal Aquifer. In addition, most of the site lies within a SPZ2 for Bristol Water's Chelvey source, which is used for public water supply. The Chelvey source has a **very high** sensitivity.

13.10.2 The aquifer also supplies baseflow or spring flow to surface water around the application site and these form **high** sensitivity receptors. Recharge over the application site is an important component of the water resources for this aquifer and any loss of resource has the potential to affect the status of the aquifer; flows at Chelvey; and flows at springs and surface watercourses. These are also sensitive receptors.

13.10.3 Water quality in the aquifer is of generally good quality, which is reflected in its use for public water supply and any pollution of the aquifer has the potential to adversely affect the Chelvey source (e.g. by requiring treatment) and aquatic organisms in surface water fed by springs or baseflow.

13.10.4 However, the Chelvey source is distant from the application site (3.5km) as are springs or surface watercourses. Travel times of potential contaminants in groundwater from the point of entry into the aquifer to the receptors are likely to be long and this will allow time for attenuation of contaminants before they reach the receptor. Attenuation will reduce both the concentration and quantity of contaminant reaching receptors.

13.10.5 It is of note that the Proposed Development consists of similar activities to existing operations and that existing operations incorporating good practice have had no effect on groundwater resources or groundwater quality in the aquifer beneath the application site.

Construction phase

13.10.6 In the construction phase the potential effects are:

- **Increased turbidity due to soil disturbance as a result of excavations**. The aquifer beneath the application site is sensitive to turbidity. However, the mitigation measures that will be incorporated will limit the potential for turbid water to enter the ground. Embedded mitigation measures will be set out in a CEMP (**Appendix 2B**) which has been prepared to manage and minimise the potential environmental effects of construction activities. This will cover pollution, visual effects, noise, dust, ground conditions, traffic, sensitive ecological and archaeological areas, protected species, the water environment and any necessary supervision by an ecological or archaeological clerk of works. It will incorporate construction best practice (where appropriate). Specific embedded measures relevant to the protection of groundwater are that: runoff generated by construction activity will be treated to remove silt or turbidity before discharge to ground or sewer by passing through silt traps. In addition, the distance from construction sites to the more sensitive receptors will allow for attenuation of any turbid water. As a result, the magnitude of change is **very low** and effect significance is **minor or negligible**;
- **Pollution as a result of leaks or spills of fuel oils used by construction equipment**. The aquifer beneath the application site is sensitive to pollution. To minimise leaks or spills of fuels, all equipment will be inspected for leaks on a frequent basis (minimum daily) and any leaking equipment repaired immediately. Vehicles will be stored or parked on hardstanding. Spill response materials will be held on the application site for the duration of the works. These mitigation measures will minimise the potential for leaks and spills and limit their effect. In addition, the depth to the aquifer, will result in the attenuation of minor spills and leaks before they reach the water table. Furthermore, the distance from construction sites to the more sensitive receptors will permit time for attenuation of contaminants. As a result, the magnitude of change is **very low** and the effect significance is **minor to negligible**; and
- **Temporary loss of groundwater resources due to water being directed away from construction areas to surface water**. Water resources in the aquifer beneath the application site are important and therefore the aquifer is sensitive to loss of resources. However, any loss of resource will be limited to a relatively small area of the site and also be limited in time because it will only occur during the construction phase in the areas that are being worked on at any one time. As a result, the magnitude of change is **very low** and the effect significance is **minor or negligible**.

Operational phase

13.10.7 In the operational phase, the potential effects are:

- Activities on the areas of hardstanding will involve the use of potentially polluting materials, principally in the form of fuel oils but also de-icers. Spills or leaks of these materials have the potential to pollute groundwater beneath the application site;
- The new area of parking (Silver Zone Car Park Extension (Phase 2)) will be constructed over permeable paving. Leaks and spills here have the potential to discharge directly to groundwater and cause groundwater pollution;
- Pollution of groundwater could affect the status of the groundwater body beneath the application site; the operation of Chelvey Well and the WFD status of local rivers via baseflow affecting their ecological and chemical status; and
- The additional hard surfaces including new buildings, aprons, taxiways, carparks, yards and roads will reduce direct infiltration of rainfall recharge to the ground. This has the potential to reduce the volume of water entering the ground and hence reduce the groundwater resource

available. Reduced groundwater resources could affect the operation of the public water supply at Chelvey Well and reduce baseflow to local rivers.

13.10.8 The aquifer beneath the application site is sensitive to both pollution and loss of water resources, and the downgradient receptors (Chelvey and springs) are very sensitive. However, the mitigation measures that will be incorporated will limit the potential for contaminants to enter the ground and will ensure that there is no loss of resources.

13.10.9 During operation, discharges to groundwater will be controlled via an Environmental Permit. This will seek to prevent the entry of hazardous substances and limit the entry of non-hazardous pollutants to groundwater through:

- Setting out good practice for the handling of fuels and other potential pollutants;
- Ensuring competency of staff involved in the handling of fuels and other potential pollutants;
- The use of pollution control measures at the surface and by-passing water through a treatment system prior to discharge to ground. Treatment will consist of full retention oil: water separators. In areas where refuelling takes place, penstocks will be used to impound spills and prevent their entry into the ground; and
- Ongoing groundwater monitoring to provide early warning of pollution of groundwater prior to it reaching sensitive downgradient receptors.

13.10.10 In addition, the thick unsaturated zone beneath the application site and the distance between the Proposed Development and the more sensitive receptors will allow for attenuation of any contaminants that enter the ground as a result of leaks and spills. As a result, the magnitude of change for all receptors as a result of the operation of the Proposed Development is **very low** and the effect significance is **minor or negligible**.

13.10.11 A summary of the results of the assessment for the operational phase on groundwater is provided in **Table 13.13**.

Table 13.13 Summary of significance of adverse effects during the construction phase and operational phase

Receptor and summary of predicted effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of change[2]	Significance[3]	Summary rationale
Construction phase				
Increased turbidity due to soil disturbance as a result of excavations	High	Very low	Minor/negligible (not significant)	The aquifer beneath the application site is sensitive to turbidity. However, the mitigation measures that will be incorporated will limit the potential for turbid water to enter the ground. In addition, the distance from construction sites to the more sensitive receptors will allow for attenuation of any turbid water.
Pollution as a result of leaks or spills of fuel oils used by construction equipment	High	Very low	Minor/negligible (not significant)	The aquifer beneath the application site is sensitive to pollution. However, the introduction of mitigation measures will minimise the potential for leaks and spills and limit their effect. The depth to the aquifer, will result in the attenuation of minor spills and leaks before they reach the water table.
Temporary loss of groundwater resources due to water being directed away from construction areas to surface water	High	Very low	Minor/negligible (not significant)	Any loss of resource will be limited to a relatively small area will be temporary, occurring over a short time period. This is because it will only occur during the construction phase in the areas that are being worked on at any one time.
Operational phase				
Groundwater beneath and downgradient of the application site in the Principal Aquifer - pollution	High	Very low	Minor/negligible (not significant)	Existing operations incorporating good practice have had no observable effect on the aquifer beneath the application site and are operated under an Environmental Permit. The extensive unsaturated zone beneath the application site will allow for adequate attenuation of any contaminants. During operation, discharges to groundwater will be controlled via an Environmental Permit. This will seek to prevent the entry of hazardous substances and limit the entry of non-hazardous pollutants to groundwater.
Chelvey Well Public Water Supply - pollution	High	Very low	Minor/negligible (not significant)	Existing operations incorporating good practice have had no observable effect on the aquifer beneath the application site. Chelvey Well is also some 3.5km distant from the Proposed Development. Travel time to the receptor is likely to be long allowing time for attenuation of contaminants before they reach the receptor. Groundwater

Receptor and summary of predicted effects	Sensitivity/ importance/ value of receptor[1]	Magnitude of change[2]	Significance[3]	Summary rationale
				monitoring at Bristol Airport will provide early warning of adverse trends in groundwater quality before it reaches the well. During operation, discharges to groundwater will be controlled via an Environmental Permit. This will seek to prevent the entry of hazardous substances and limit the entry of non-hazardous pollutants to groundwater.
Chelvey Well Public Water Supply – water resources	High	Very low	Minor/negligible (not significant)	The use of infiltration drainage (e.g. in car parks) will maintain water resources.
Springs or baseflow to surface water - pollution	High	Very low	Minor/negligible (not significant)	Existing operations incorporating good practice have had no observable effect on the aquifer beneath the application site. The nearest spring is more than 2km from the application site and may not receive water from beneath Bristol Airport. Travel time to the receptor is likely to be long allowing time for attenuation of contaminants before they reach the receptor. During operation, discharges to groundwater will be controlled via an Environmental Permit. This will seek to prevent the entry of hazardous substances and limit the entry of non-hazardous pollutants to groundwater.
Springs / baseflow to surface water – water resources	High	Very low	Minor/negligible (not significant)	The use of infiltration drainage (e.g. in the car parks) will maintain water resources.

1. The sensitivity/importance/value of a receptor is defined using the criteria set out in **Section 13.9** above and is defined as very low, low, medium, high and very high.
2. The magnitude of change on a receptor resulting from activities relating to the development is defined using the criteria set out in **Section 13.9** above and is defined as very low, low, medium, high and very high.
3. The significance of the environmental effects is based on the combination of the sensitivity/importance/value of a receptor and the magnitude of change and is expressed as major (significant), moderate (probably significant) or minor/negligible (not significant), subject to the evaluation methodology outlined in **Section 13.9**.

13.11 Consideration of optional additional mitigation or compensation

13.11.1 No additional mitigation measures are proposed to further reduce the groundwater effects that are identified in this ES. This is because all relevant and implementable measures have been embedded into the Proposed Development proposals and are assessed in this chapter. These measures are considered to be likely to be effective and deliverable and address the likely significant effects of the Proposed Development.

13.12 Conclusions of significance evaluation

13.12.1 This assessment has concluded that there are no significant effects on groundwater as a result of the Proposed Development after taking into account the embedded mitigation measures.

13.13 Implementation of environmental measures

13.13.1 **Table 13.14** describes the environmental measures embedded within the Proposed Development and the means by which they will be implemented, i.e. they will have been secured through planning conditions and by complying with the Bristol Airport Environmental Permit.

Table 13.14 Summary of environmental measures to be implemented – relating to groundwater

Environmental measure	Responsibility for implementation	Compliance mechanism	ES section reference
Water management during construction	Developer or contractor	Planning condition or CEMP (**Appendix 2B**)	**Section 13.10**
Pollution control measures	Developer	Environmental Permit	**Section 13.10**
Groundwater infiltration	Developer	Planning condition	**Section 13.10**
Groundwater monitoring	Developer	Planning condition	**Section 13.10**