Appendix A

TOPIC BASED SCHEMES ASSESSMENT: AoS FOR AIRPORTS NPS

A-6 SOILS

June 2018

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6 SOILS

6.1 INTRODUCTION

6.1.1 This topic based assessment considers each airport expansion scheme under the Soil topic. These are London Heathrow Extended Northern Runway (LHR-ENR), London Heathrow Northwest Runway (LHR-NWR) and London Gatwick Second Runway (LGW-2R) (together the shortlisted schemes).

6.1.2 By law, before designating an Airports National Policy Statement (NPS) an Appraisal of Sustainability (AoS) must be carried out. This AoS is a strategic level assessment. It is based on the contents of the Airports NPS. The AoS considers alternatives to the Government's preferred scheme as set out in the Airports NPS, including the outline masterplans supplied to the Airports Commission for the three shortlisted schemes. This AoS considers the impacts of expansion without the benefits of the mitigation packages put forward by scheme promoters, unless stated otherwise. The Government has outlined that it expects a significant mitigation package to be put in place by the promoter of its preferred scheme to ensure that wherever possible significant effects are avoided, reduced or offset.

6.1.3 Further project-level design will be required which will inform an environmental impact assessment carried out by the promoter. This would include an assessment, which is likely to include effects identified in the AoS as well as more detailed mitigation developed as detailed design progresses. This will also be developed through consultation with both affected communities and other stakeholders.

6.1.4 This assessment builds on the previous assessment undertaken as part of the Airports Commission's (AC) Appraisal Framework but also responds to the AoS Appraisal Framework. The Framework addresses Soil issues which have been identified through a review of plans, policies and programmes, and also the landscape baseline.

6.1.5 Each expansion scheme is considered against the AoS Appraisal Framework Objectives, and Questions. The Objectives and Questions which are addressed within this assessment are as follows:

- **AoS Objective 9:** To protect sites designated for geodiversity.
  - **AoS Question 15**: Will it preserve, protect and improve geodiversity?
- **AoS Objective 10**: To minimise loss of undeveloped soils and of Best and Most Versatile agricultural land, and protect soil against erosion, contamination and degradation.
  - **AoS Question 16**: Will it maximise construction on previously developed land, minimise use of Greenfield and Best and Most Versatile agricultural land?
  - **AoS Question 17**: Will it lead to the disturbing, harm, contamination or loss of soil resources?

6.2 POLICY AND LEGISLATION

6.2.1 The following policy and legislation relevant to the Soils assessment are summarised below and their context and applicability is explained as appropriate in the relevant sections of the assessment. Other topic specific policy and legislation has been covered within specific topic sections.

6.2.2 Soils, geology and the use of land are protected by the following policies in the UK.

EU Thematic Strategy for Soil Protection 2006[1]

6.2.3 The Thematic Strategy calls for a framework directive and hence advocates higher levels of protection to the soil resource. Eight major threats to soil are identified within the Thematic Strategy, as follows:

- Erosion;
- Organic matter decline;
- Contamination;
- Salinization;
- Compaction;
- Soil biodiversity loss;
- Sealing; and
- Landslides and flooding.

6.2.4 The aims of the Thematic Strategy are supported in UK Government policy for England in Defra's *Safeguarding our Soils: A Strategy for England* published 2009[2].

The National Planning Policy Framework 2012 (NPPF)[3]

6.2.5 The NPPF set out the Government's planning policies for England and how these are expected to be applied. Paragraph 3 of the NPPF states the NPPF does not contain specific policies for nationally significant infrastructure projects (NSIPs). These are determined in accordance with the decision-making framework set out in the Planning Act 2008 and relevant national policy statements for major infrastructure, as well as any other matters that are considered both important and relevant (which may include the NPPF).

6.2.6 A core principle of the NPPF, set out in Paragraph 17, is that planning should encourage the effective use of land by reusing land that has been previously developed (brownfield land), provided that it is not of high environmental value.

6.2.7 Paragraph 109 of the NPPF states that the planning system should contribute to and enhance the natural and local environment by:

- Protecting and enhancing valued landscapes, geological conservation interests and soils;
- Preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability; and
- Remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.

6.2.8 Best and Most Versatile (BMV) agricultural land is the land which is most flexible, productive and efficient and which can best deliver future crops for food and non-food uses such as biomass, fibres and pharmaceuticals. Paragraph 112 of the NPPF states that Local Planning Authorities should take into account the economic and other benefits of BMV agricultural land.

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[1] Commission of the European Communities, 2006. *Thematic Strategy for Soil Protection*. [online] Accessed 04/01/2017.
[2] Defra, 2009. *Safeguarding our Soils, A Strategy for England*. [online] Accessed 04/01/2017.
[3] Department for Communities and Local Government, 2012. *National Planning Policy Framework,* p. 50. [online] Accessed 25/02/2016.

The NPPF defines BMV land as land in Grades 1, 2 and 3a of the Agricultural Land Classification (ALC)[4].

Environmental Protection Act 1990 and the Contaminated Land (England) Regulations 2006 (HMSO, 2006) as amended by the Contaminated Land (England) (Amendment) Regulations 2012

6.2.9 The contaminated land regime, contained within Part 2A of the Environmental Protection Act 1990, is the legislative framework for the management of land affected by contamination in the UK.

6.2.10 The Contaminated Land (England) Regulations 2000 (as amended) set out provisions relating to the identification and remediation of contaminated land under Part 2A of the Environmental Protection Act 1990. Part 2A requires local authorities to identify and remediate land posing a significant risk to human health or the environment.

6.2.11 During construction, the potential contaminated land implications of the proposed developments are considered to include risks to human health due to coming into contact with contaminated land, risks to construction workers and off site residents due to dust and vapour. During operation, the potential implications are considered to be risks to human health from ground gasses, and risks to human health and the wider environment, including to surface and groundwater from spills, leaks and de-icing.[5]

Groundwater Directive (2006/118/EC)

6.2.12 The Groundwater Directive sets objectives for groundwater quality, including an objective to meet "good chemical status" by 2015, an objective on pollution trends, and an objective to prevent or limit the input of pollutants to groundwater.

6.2.13 The Groundwater Directive is designed to prevent and combat groundwater pollution. Its provisions include:

- → Criteria for assessing the chemical status of groundwater;
- → Criteria for identifying significant and sustained upward trends in groundwater pollution levels and for defining starting points for reversing these trends; and
- → Preventing and limiting indirect discharges (after percolation through soil or subsoil) of pollutants into groundwater.

6.2.14 The Groundwater Directive is transposed and implemented into law in England and Wales by the Groundwater (England and Wales) Regulations (2009), the Environmental Permitting Regulations (2010), and two Directions provided to the Environment Agency by the Secretary of State: the first setting out principles for classifying groundwater water bodies[6] and the second setting out water quality standards and groundwater threshold values[7].

Waste Framework Directive (2008/98/EC)

6.2.15 The Waste Framework Directive sets the basic concepts and definitions related to waste management. These include the definitions of waste, recycling and recovery. It explains when waste ceases to be waste and becomes a secondary raw material (so called "end-of-waste criteria"), and how to distinguish between waste and by-products. The Waste Framework

[4] Ministry of Agriculture, Fisheries and Food, 1988. *Agricultural Land Classification of England and Wales, Revised guidelines and criteria for grading the quality of agricultural land*. [online] Accessed 04/01/2017.
[5] Jacobs, 2014. 10. *Place: Assessment,* p. 130. [online] Accessed 23/12/2015.
[6] Defra, 2009. *River Basin Districts Surface Water and Groundwater Classification (Water Framework Directive) (England and Wales) Direction 2009*. [online] Accessed 04/01/2017.
[7] Defra, 2010. *The River Basin districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010*. [online] Accessed 04/01/2017.

Directive lays down some basic waste management principles; it requires that waste be managed without endangering human health and harming the environment, and in particular without risk to water, air, soil, plants or animals, without causing a nuisance through noise or odours, and without adversely affecting the countryside or places of special interest.

6.2.16 The Waste Framework Directive introduces the "polluter pays principle" and "extended producer responsibility". It incorporates provisions on hazardous waste and waste oils (old Directives on hazardous waste and waste oils being repealed with effect from 12 December 2010), and includes two new recycling and recovery targets to be achieved by 2020: 50% preparing for re-use and recycling of certain waste materials from households and other origins similar to households; and 70% preparing for re-use, recycling and other recovery of construction and demolition waste.

6.2.17 The Waste Framework Directive is transposed and implemented into law in England and Wales by the Waste (England and Wales) Regulations 2011 (as amended).

Natural Environment White Paper: 'The Natural Choice: securing the value of nature'[8]

6.2.18 This Natural Environment White Paper (NEWP) emphasises the importance of natural resource protection, including the conservation and sustainable management of soils. The white paper echoes the approach to conservation and sustainable management of soils described in the NPPF, that the planning system should seek to:

- Protect BMV agricultural land (Grades 1, 2 and 3a in the ALC) as a resource for the future;
- Avoid development that would disturb or damage other soils of high environmental value; and
- Ensure soil resources are conserved and managed in a sustainable way for the ecosystem services they provide.

6.3 BACKGROUND TO THE ASSESSMENT

6.3.1 The assessment is based on the following reports:

- Airports Commission, 2015. *Final Report* [9];
- Jacobs, 2014. *10. Place Assessment*[10]; and
- Jacobs, 2014. *10. Place: Baseline*[11].

6.3.2 Additional work has also been undertaken for this AoS, comprising a consideration of impacts on geodiversity and BMV agricultural land.

6.3.3 The assessment of potential effects on geodiversity considers sites within 5km of the schemes which are designated for their geological significance or sensitivity, including:

- Sites of Special Scientific Interests (SSSIs) which provide statutory legal protection for geologically important sites in the UK; and
- Regionally important geological and geomorphological sites (RIGS) are non-statutory locally designated sites of local, national and regional importance for geodiversity (also referred to as Local Geological Sites in England).

6.3.4 The 5km study area around the scheme site boundaries includes geological sites which are potentially affected either directly, through land take, or by other environmental effects. Geological SSSIs were identified using Defra's *Magic Map* application.[12] RIGS were identified

[8] Defra, 2011. *The Natural Choice; securing the value of nature*. [online] Accessed 04/01/2017.
[9] Airports Commission, 2015. *Final Report*. [online] Accessed 24/12/2015.
[10] Jacobs, 2014. 10. *Place Assessment.* [online] Accessed 23/12/2015.
[11] Jacobs, 2014. 10. *Place: Baseline*. [online] Accessed 23/12/2015.
[12] Defra, 2015. *Magic M*ap. [online] Accessed 24/12/2015.

using the General Conservation Review (GCR) database maintained by the Joint Nature Conservation Committee (JNCC)[13] and publically available information from local authority websites. All RIGS are GCR sites (and the vast majority of GCR sites are RIGS).

6.3.5 The assessment of impacts on BMV agricultural land has been informed by review of the ALC Strategic Map – Likelihood of BMV Agricultural Land Dataset[14]. This map provides predictions about the location of agricultural land, and the likelihood that it is BMV land.

6.3.6 The NPPF[15] provides the definition of Previously Developed Land (PDL). The Jacobs Place Assessment does not quantify loss of PDL in accordance with this complex definition, but the definition excludes agricultural land which has not previously been developed for uses other than agriculture. In accordance with the NPPF, maximising the use of PDL provides the benefit of protecting soils and agricultural land. For the purposes of this assessment, the relationship between PDL and Agricultural Land is considered to be closely related. The greater the proportion of agricultural land used the smaller the proportion of PDL that has been reused.

6.4 INTERACTION WITH OTHER TOPICS

6.4.1 The assessment of soils is closely related to other topic-based assessments in the AoS. In particular, the following interactions are noted in Table 6.1.

Table 6.1: Interaction of the Soils topic with other topics.

AoS Topic	Interaction
Carbon	Soils and vegetation absorb and store carbon. Loss of land and vegetation will reduce the capacity of the landscape to absorb carbon emissions, and may result in the release of stored carbon into the atmosphere.
Water	Water plays a significant role in soil processes and is a key aspect for mobilisation of contaminants. Infiltration of rainwater is an important factor in flood risk.
Waste and Resources	Soil can become waste if not reused on site, requiring a resource efficient approach to materials management. Contaminated soils may affect waste management. Generation of certain types of waste also has the potential to contaminate soils.
Landscape and biodiversity	Soil type and nutrients determine the ecosystems that they can support (and landscape features). Sites designated for geological interest may have inter-related biodiversity interest.

6.5 ASSESSMENT CRITERIA

6.5.1 The general criteria used for assessing the significance of effects within the AoS are set out in the methodology in Section 3 of the AoS Report to which this appendix is attached. Identification of significance is set out in Table 6.2 below.

[13] JNCC, 2011. *GCR Database*. [online] Accessed 24/12/2015.
[14] Natural England, 2012. *ALC Strategic Map – Likelihood of BMV Agricultural Land Dataset*. Natural England: York.
[15] Department for Communities and Local Government, 2012. *National Planning Policy Framework,* p. 55. [online] Accessed 25/02/2016.

Table 6.2: Identification of Significant Effects in the AoS.

++	*Significant positive effect*
+	*Positive effect*
-	*Negative effect*
--	*Significant negative effect*
+/-, ++/--	*Mixed positive and negative effect*
?	*Uncertain effect*
0	*No relationship / neutral effect*

6.5.2 It should be noted that schemes are assessed individually against the requirements of the Strategic Environmental Assessment (SEA) Regulations and presented together for comparison. This means that although the nature of effects can vary between schemes, the significance may be the same.

6.6 SUMMARY OF BASELINE AND ISSUES

NATIONAL BASELINE

6.6.1 Geology and soils influence the use of the land and the characteristics of the communities that live and work on the land. Soils and geology influence vegetation and water with effects also linked to landscape, biodiversity, cultural heritage and material assets including food production. Some geological formations and soils are also important as mineral resources for earth science, archaeology and ecology.

6.6.2 Soil is a non-renewable resource. It is vulnerable to erosion, degradation, contamination and sealing. Soil sealing is the covering of the soil surface with an impervious material or the changing of its nature so that the soil becomes impermeable.[16] Urban development and construction of transport infrastructure are the main causes of almost irreversible net soil loss and sealing. Soil sealing prevents the soil from performing other functions such as food and fibre production, water infiltration and drainage or the ecological functions of soil, including storage of carbon and as a habitat. Various existing sources of contamination and contaminated land have been identified at each of the expansion schemes[17], these include existing or historic landfill sites, and registered pollution incidents, and these are described in more detail for each scheme below.

6.6.3 Soils, geology and the use of land are protected by UK and European policy, as described in Section 1.2, above; in particular, the EU's Thematic Strategy for Soil Protection (2006), which aims to prevent soil degradation and preserve its functions. Soils in England face the following threats which are magnified by climate change[18]:

- → Soil erosion by wind and rain. Erosion affects both the productivity of soils but also water quality and aquatic ecosystems;

[16] Defra, 2006. *The Environment: Quality and safety: Land: Soil: Built environment: Soil sealing*.
[17] Jacobs, 2014. *10. Place: Assessment,* pp. 113-123. [online] Accessed 24/12/2015.
[18] Defra, 2009. *Safeguarding our Soils: A Strategy for England.* [online] Accessed 24/12/2015.

- Compaction of soil reduces agricultural productivity and water infiltration, and increases flood risk through higher levels of run off;
- Organic matter decline. The loss of soil organic matter reduces soil quality, affecting the supply of nutrients and making it more difficult for plants to grow, and increases emissions to the atmosphere; and
- Loss through sealing, or other degradation or contamination caused by construction or human activity.

6.6.4 All of the airport expansion sites include large areas of agricultural land. The impacts on this land are described later in this assessment. Agricultural land is a finite and irreplaceable resource. ALCs Grade 1, 2 and 3a are the most productive uses, and are protected as BMV land. Loss of PDL[19] is preferable to the use of agricultural land.

LOCAL BASELINE

LGW-2R

6.6.5 No Geological SSSIs have been identified within 5 km of the site boundary. Newdigate (North) RIGS was identified 5 km northwest of Gatwick Airport.

6.6.6 The airport expansion site will require land take of 624 ha, with a further 78.2 ha potentially lost for surface access, resulting in a total potential land take of 702 ha. A range of sources and pathways for contamination have been identified within the site boundary.[20] These include:

- One historical landfill;
- One licensed waste management facility;
- 18 registered pollution incidents (one of which is classed as major, chemicals unknown);
- Three historical land uses which might cause contamination are identified;
- Agriculture on adjacent land;
- Various industrial uses (workshops, storage depots, and retail/business parks); and
- Military use of Gatwick Airport and Gatwick Racecourse (now part of Gatwick Airport) during the Second World War.

6.6.7 Jacobs Engineering UK Ltd. did not identify substantial levels of soil contamination in a contaminated land assessment of the Pier 1 and Pier 2 areas of the site undertaken in 2010[21]. Pier 1 and Pier 2 are identified in the 2010 report as '*the existing southern and central aircraft stands attached to the South Terminal building*'. A further five registered pollution incidents are identified within 250 m of the site (one of which is classed as significant).

6.6.8 Underlying geological formations, groundwater and surface water are identified as potentially sensitive environmental receptors. These are as follows:

- Bedrock primarily comprises the Weald Clay Formation (Unproductive Strata), with limited areas of Ironstone Weald Clay (Unproductive Strata) and Upper Tunbridge Wells Sands (Secondary A Aquifer). Superficial deposits comprise River Terrace Deposits (Secondary A Aquifer), Alluvium (Secondary A Aquifer), and Quaternary head deposits (Secondary Undifferentiated Aquifer).
- There are five main watercourses within the site boundary, four with moderate ecological status: River Mole (Crawley to Gatwick), River Mole (Gatwick Airport), Mans Brooke, and

[19] Planning Portal, 2016. *Previously Developed Land or 'Brownfield Land'*. [online] Accessed 12/12/2016.
[20] Jacobs, 2014. 10. *Place: Assessment,* p. 113. [online] Accessed 24/12/2015.
[21] Jacobs, 2010. Ga*twick Airport – Pier 1 and Pier 2 Development, Contaminated Land Site Investigation Interpretative Report*. [online] Accessed 04/01/2017.

Tilgate Brooke. The fifth, River Mole (Horley to Hersham), has poor ecological status. The site is not situated within a Nitrate Vulnerable Zone (NVZ).

- There are no Source Protection Zones (SPZs) within the site boundary. The nearest SPZ (Total Catchment, Zone 3) is situated approximately 7 km to the north.
- The nearest groundwater abstraction licence is approximately 1 km south of Gatwick Airport, in Crawley, and is classified as medium size. There are no other groundwater or surface water abstractions within a 2 km radius of Gatwick Airport.

6.6.9 The site area of the airport and surface access systems incorporates 421 ha of agricultural land, representing approximately 67% of the total land use within the land take area. The Ecosystem Services Assessment (ESA) undertaken on behalf of the AC acknowledges the value of agricultural land for food provision, particularly food crops[22].

LHR-ENR

6.6.10 No Geological SSSIs or RIGS have been identified within 5 km of LHR-ENR.

6.6.11 The airport expansion site will require land take of 336 ha, with a further 330 ha potentially lost for surface access, 57 ha of flood storage, resulting in a total potential land take of 723 ha[23]. The primary land use within the land take area is agriculture; other major land use classes include industry and business, transport, and forestry.

6.6.12 For the purposes of this assessment, the baseline conditions at LHR-ENR are not expected to vary materially from those of the LHR-NWR scheme.[24] The following sources of contamination have been identified:

- Historical landfills and industrial activity; and
- A press report dated September 2010 indicates a fuel support pipeline leak in which at least 139,000 litres of aviation fuel entered the ground in the vicinity of the Heathrow Terminal 1 building, affecting the groundwater in the underlying Taplow Gravels.

6.6.13 Underlying geological formations, groundwater and surface water are identified as potentially sensitive environmental receptors. These are as follows:

- Bedrock comprises the London Clay Formation (Unproductive Strata). Superficial deposits include various alluvial deposits potentially including the Langley Silt Member, Shepperton Gravel Member, and Lynch Hill Gravel Member (described as principal aquifers or unproductive strata with no further details given). There are no SPZs within the site boundary;
- Two groundwater and one surface water abstraction license(s) are identified (no further details provided). The eastern part of the site is situated within a surface water NVZ;
- There are four rivers within the site boundary, each with moderate ecological status, as well as numerous ponds and lakes. The site is situated within a NVZ;
- There are no SPZs within the site boundary. The nearest SPZs (Total Catchment, Zone 3) are situated approximately 2 km northwest and southwest of the site; and
- Two groundwater and one surface water abstraction licence(s) are identified. The eastern part of the site is situated within surface water NVZ.

[22] Jacobs, 2014, 7. *Ecosystem Services*. [online] Accessed 20/06/2016.
[23] Jacobs, 2014. *10. Place: Assessment*, p. 23, Table 2.21. [online] Accessed 04/01/2017.
[24] Jacobs, 2014. *10. Place: Assessment*, p. 152. [online] Accessed 24/12/2015.

6.6.14 The site area of the airport and surface access systems incorporates 371ha of agricultural land, representing approximately 50% of the land use within the land take area. The ESA undertaken on behalf of the AC acknowledges the value of agricultural land for food provision, particularly food crops.

LHR-NWR

6.6.15 No Geological SSSIs or RIGS have been identified within 5 km of LHR – NWR.

6.6.16 The airport expansion site will require land take of 569 ha, with a further 294 ha potentially lost for surface access. Including flood storage areas (an additional 43ha of land), the scheme will result in a total potential land take of 906 ha. The primary land use within the land take area is agriculture; other major land use classes include recreation and leisure, industry and business, transport, forestry, and residential.

6.6.17 A range of sources and pathways for contamination have been identified within the site boundary.[25] These include:

- Two active landfills;
- 16 historical landfills; and
- 11 registered pollution incidents (five of which are classed as significant, involving oils, chemicals, inert material/waste, and miscellaneous pollutants) are identified within the site boundary.

6.6.18 Various other historic on-site and off-site land uses have been identified as potential contamination sources, including:

- A fire engine house, a road research laboratory, gravel (and other) pits, a sand and ballast works, an energy from waste plant, a disused railway, various fuel stations and several large distribution warehouses; and
- A press report dated September 2010 indicates a fuel support pipeline leak in which at least 139,000 litres of aviation fuel entered the ground in the vicinity of the Heathrow Terminal 1 building, affecting the groundwater in the underlying Taplow Gravels.

6.6.19 Underlying geological formations, groundwater and surface water are identified as potentially sensitive environmental receptors. These are as follows:

- Bedrock comprises the London Clay Formation (Unproductive Strata). Superficial deposits include Alluvium (Secondary A Aquifer) and River Terrace Deposits (Principal Aquifer). Groundwater vulnerability is medium to high, due to soil permeability;
- There are no SPZs within the site boundary. The nearest SPZs (Total Catchment, Zone 3) are situated approximately 2 km northwest and southwest of the site; and
- Two groundwater and one surface water abstraction licence(s) are identified. The eastern part of the site is situated within surface water NVZ.

6.6.20 The site area of the airport and surface access systems incorporates 431ha of agricultural land. This is approximately 50% of the total land use within the land take area. The ESA undertaken on behalf of the AC acknowledges the value of agricultural land for food provision, particularly food crops.

FUTURE BASELINE AND ISSUES

6.6.21 The Jacobs Place: Baseline report[26] identified the following general future baseline trends within the Thames area:

[25] Jacobs, 2014. *10. Place: Assessment*, p. 129. [online] Accessed 24/12/2015.

- Agriculture - The total area devoted to farming has been decreasing;
- Settlement and Development - London has an expanding population and pressure to meet housing demand and other changes is placing pressure on existing greenspace which varies considerably in quality. Developments and their surrounding countryside have been subsumed into a wide urban area, causing increasing urbanisation; and
- Climate change - The Environment Agency predicts that peak river flows may increase by 20% in the future. Also frequent, short duration, intense storms in the summer are likely to cause more widespread and regular "flash" flooding from overwhelmed drainage systems and some rivers. Therefore agricultural land is at risk from soil erosion and nutrient loss as the soil becomes more susceptible to wind erosion in the predicted hotter and drier periods and water erosion in the wetter, colder periods. It is estimated for example, that fluvial flows entering the tidal river at Teddington will increase by up to 40% by 2080.

6.7 MITIGATION INCLUDED IN ASSESSMENT

6.7.1 As with any major construction project, there is an increased risk of pollution and potential contamination of soils. However, it is assumed that potential negative effects could be addressed by adopting measures detailed below, which are often expected for a large infrastructure project. The mitigation provides additional detail to the proposals that have been submitted by the airport expansion scheme promoters as it is considered that these are widely applied in the construction industry.

6.7.2 All proposed works should be carried out in accordance with the following guidance documents:

- HSE, 2006. *Health and Safety in Construction*[27]. This document establishes the key principles to take into account when designing and implementing work on contaminated sites, in order to ensure the proper protection of the health and safety of employees and others who may be affected by such work;
- Steeds *et al*., 1996. A Guide to Safe Working on Contaminated Sites: R132[28]. This document includes checklists to help in the preparation of health and safety risk assessments, the development of safe working practices, etc; and

6.7.3 A scheme-specific Construction Environmental Management Plan (CEMP) could be developed detailing option-specific mitigation, drawing on the *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites.*[29] The CEMP is a live document that will be continually updated in consultation with the Statutory Environmental Bodies (SEBs). Typically, the CEMP will include procedures for managing the earthworks during the cut and fill activities such as stockpile control. The CEMP could also set out procedures to mitigate against sediment run-off associated with the stockpiling of soils, will set out waste storage areas and relevant permitting regulations and mitigation plans.

6.7.4 It is assumed that all materials that are to be re-used in the scheme will need to be done so in accordance with a relevant environmental permit / Soil Resource Plan and Materials Management Plan. Site-specific re-use criteria will require derivation by a suitably qualified person and these will apply to any soils that are proposed for re-use to ensure that the materials do not represent a risk to human health and the wider environment. The derivation of such criteria and adherence to this process will in turn mitigate many of the risks associated with the presence of potential contamination in the ground and contact with construction works/end users.

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[26] Jacobs, 2014. *10. Place: Baseline*. [online] Accessed 23/12/2015.
[27] HSE, 2006. *Health and safety in construction, HSG150 (Third Edition)*. [online] Accessed 24/12/2015.
[28] Steeds, J. E., Shepherd, E. and Barry, P. L., 1996. *Guide to Safe Working on Contaminated Sites: R132*. CIRIA: London.
[29] Defra, 2011. *Construction code of practice for the sustainable use of soils on construction sites*. [online] Accessed 18/02/2016.

6.7.5 The main impact of the scheme will be associated with soil stripping and stockpiling. Mitigation measures will be implemented in accordance with the *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites* and are likely to include:

- Soil stripping based on a Soil Resource Plan (informed by a Soil Resource Survey), which can inform a Materials Management Plan or Site Waste Management Plan;
- Storage of soils in temporary low stockpiles, protected from contamination by other materials and sown with grass if being stored for more than 6 months;
- Spreading of topsoils only on subsoils that have been de-compacted;
- No repetitive handling of soils;
- The use of bunds to prevent run-off, including silt, entering watercourses;
- Design of runoff control features to minimise soil erosion;
- The use of appropriate structures at culvert outlets to prevent erosion;
- Clean and maintain drainage ditches and culverts on a regular basis; and
- The use of regular inspection to assess effectiveness of and the maintenance requirements for erosion and sediment control systems.

6.7.6 During the construction there is potential that previously unidentified contamination is encountered during earthworks. It is assumed that this material will be chemically tested and assessed against derived criteria (completed during the ground investigation) before being removed or remediated.

6.7.7 Risks to construction workers during the construction phase of the scheme will be mitigated by the correct implementation of Health and Safety measures, such as suitable working methods and the correct use of personal protective equipment (PPE). These will be developed as part of the CEMP for the scheme. For further guidance, reference is made to the Health and Safety Executive document EH40 'Workplace Exposure Limits'[30]. The protective measures are considered standard practice and include the following:

- Selection of appropriate PPE (eg gloves and overalls);
- Implementation of best practice procedures such as washing hands before eating, no eating in the work area;
- Clear signage of contaminated land if encountered; and
- Adequate site security is required to prevent trespassers gaining access to the scheme corridor during the construction phase.

6.8 APPROACH TO ASSESSMENT OF SOILS

6.8.1 Impacts at the strategic level have been assessed for both construction and operational phases. For instance during construction, effects arise from direct loss of land or soil resources or damage due to construction activities causing for instance compaction, erosion or pollution. During operation effects would include potential for contamination of soils from operational activities. This is addressed through the consideration of the duration of the impact (short medium and long term) within the assessment.

6.8.2 When assessing potential impacts on soils from contamination, the methodology for this high level, desk based assessment is based partly upon considering the likely requirements arising from The Contaminated Land (England) Regulations (as amended) which set out provisions relating to the identification and remediation of contaminated land.

[30] Health and Safety Executive, 2011. *EH40/2005 Workplace exposure limits*. [online] Accessed 04/01/2017.

6.8.3 When assessing effects on agricultural land, the identification of potential areas and quality of agricultural land has been based on Defra's system for identifying, classifying and protecting agricultural land. The ALC system classifies land into five grades based on the potential for agricultural production: Grade 1 (excellent); Grade 2 (very good); Grade 3 which subdivided into Subgrades 3a (good) and 3b (moderate); Grade 4 (poor) and Grade 5 (very poor). Grades 1, 2 and 3a comprise the BMV agricultural land as referred to in policy guidance[31].

6.9 ASSESSMENT OF SHORTLISTED SCHEMES

Objective 9: To protect sites designated for geodiversity

LGW-2R

6.9.1 Impacts on geodiversity are considered unlikely to be significant. Newdigate (North) RIGS which is designated for geodiversity reasons is located beyond a distance at which any direct or indirect effects, which would include loss of tranquillity from noise, direct land take, air quality effects on exposed geology and contamination, are anticipated.

LHR-ENR

6.9.2 Impacts on geodiversity as a result of this proposal are not considered to be significant. No sites which are designated for geodiversity sensitivity, including Geological SSSIs or RIGS, have been identified within a 5 km radius of the proposed development.

LHR-NWR

6.9.3 Impacts on geodiversity as a result of this proposal are not considered to be significant. No sites which are designated for geodiversity sensitivity, including Geological SSSIs or RIGS, have been identified within a 5 km radius of the proposed development.

Objective 10: To minimise loss of undeveloped soils and of Best and Most Versatile agricultural land, and protect soil against erosion, contamination and degradation

LGW-2R

6.9.4 The use of large areas of previously undeveloped land will affect the quality of soil and land resources meaning these areas of land will no longer be suitable for other uses, including farming. In addition the loss of undeveloped soil through development has the potential to affect soil quality through erosion, contamination and degradation, which in turn may pose a risk to human health and to the environment.

6.9.5 During the construction phase, it is anticipated that risks to human health may arise if construction workers are exposed to soils or made ground affected by land contamination, particularly in areas of excavation, tunnelling, or levelling.

6.9.6 Dusts and odours may be produced during construction, particularly in association with the disturbance of historical landfill or industrial materials.

6.9.7 There is a potential to encounter previously unidentified underground structures. These may pose a risk to human and environmental receptors, particularly where these are proximate to areas where accumulation of ground gases is occurring.

6.9.8 Construction activities relating to piling, excavation and drainage have the potential to create pathways allowing contaminated materials to migrate to groundwater or surface water.

[31] Natural England, 2012. *Agricultural Land Classification: protecting the best and most versatile agricultural land* (TIN049). [online] Accessed 13/10/2015.

6.9.9 Hazardous substances may enter the environment as a result of spills and leaks associated with auxiliary activities including fuelling, de-icing, servicing and maintenance.

6.9.10 The off-site disposal of construction waste arising from demolition and enabling works could result in increased dust and vehicle emissions, with implications for human health, and potential surface water contamination from run-off or hazardous wastes or insufficient on-site storage facilities.

6.9.11 Development of land will affect soil resources (including physical loss of and damage to soil resources) associated with land contamination (from potential substance release) and structural damage (from potential compaction, burial, mixing, etc). Indirect impacts may also arise from changes in the local water regime, organic matter content, soil biodiversity, and soil process.

6.9.12 Development of agricultural land through airport development in conjunction with other infrastructure development will have a cumulative effect on the availability of BMV agricultural land. Table 6-5 of the AoS Report provides a review of potential plans, policies, programmes and major infrastructure projects for cumulative effects. Potential cumulative effects on soils and agricultural land are identified with the National Networks National Policy Statement and Local Development Plans (Local Authorities of Crawley District, Horsham District, Reigate and Banstead District, Surrey County, Mole Valley District, Tandridge District, West Sussex County).

6.9.13 Mitigation will be incorporated within design, including best practice construction measures, which will reduce the potential for contamination or loss of soil resources through contamination. It is anticipated that best practice measures, which will be set out at detailed design, will avoid the creation of pathways to other sensitive environmental features. These will ensure that any potential negative effects associated with contamination or degradation of soil resources are not significant.

6.9.14 The site area of the airport incorporates approximately 421 ha of agricultural land. Natural England's Strategic map information indicates that the site may contain a proportion of BMV agricultural land'.

6.9.15 Land which is developed either for development of the airport or for surface access will effectively be permanently lost for agricultural use. The extent to which use of Greenfield or agricultural land has been minimised is not known. Greenfield (including agricultural land) is a finite resource, and its loss cannot easily be compensated through provision of land elsewhere. The loss of this land also means loss of value for food provision. The loss of 421 ha of agricultural land, at least half of which is likely to be BMV agricultural land, is a significant negative effect.

LHR-ENR

6.9.16 The use of large areas of previously undeveloped land will affect the quality of soil and land resources meaning these areas of land will no longer be suitable for other uses, including farming. In addition the loss of undeveloped soil through development has the potential to effect soil quality through erosion, contamination and degradation, which in turn may pose a risk to human health and to the environment.

6.9.17 During the construction phase, it is anticipated that risks to human health may arise if construction workers are exposed to soils or Made Ground affected by land contamination, particularly in areas of excavation, tunnelling, or levelling.

6.9.18 Dusts and odours may be produced during construction, particularly in association with the disturbance of historical landfill or industrial materials.

6.9.19 There is a potential to encounter previously unidentified underground structures. These may pose a risk to human and environmental receptors, particularly where these are proximate to areas where accumulation of ground gases is occurring.

6.9.20 Construction activities relating to piling, excavation and drainage have the potential to create pathways allowing contaminated materials to migrate to groundwater or surface water.

6.9.21 Hazardous substances may enter the environment as a result of spills and leaks associated with auxiliary activities including fuelling, de-icing, servicing and maintenance.

6.9.22 The off-site disposal of construction waste arising from demolition and enabling works could result in increased dust and vehicle emissions, with implications for human health, and potential surface water contamination from run-off or hazardous wastes or insufficient on-site storage facilities.

6.9.23 Development of land will affect soil resources (including physical loss of and damage to soil resources) associated with land contamination (from potential substance release) and structural damage (from potential compaction, burial, mixing, etc). Indirect impacts may also arise from changes in the local water regime, organic matter content, soil biodiversity, and soil process.

6.9.24 Development of agricultural land through airport development in conjunction with other infrastructure development will have a cumulative effect on the availability of BMV agricultural land.

6.9.25 Table 6-5 of the AoS Report provides a review of plans, policies, programmes and major infrastructure projects for cumulative effects. Potential cumulative effects on soils and agricultural land are identified with the National Networks National Policy Statement and Local Development Plans (Local Authorities of Runnymede District, Slough Borough, South Bucks District, Spelthorne Borough; London Boroughs of Ealing, Hammersmith and Fulham, Hounslow, Hillingdon, Richmond upon Thames and Royal Borough of Windsor and Maidenhead). Mitigation will be incorporated within design, including best practice construction measures which will reduce the potential for contamination or loss of soil resources through contamination. It is anticipated that best practice measures, which will be set out at detailed design, will avoid the creation of pathways to other sensitive environmental features. These will ensure that any potential negative effects associated with contamination or degradation of soil resources are not significant.

6.9.26 Natural England's Strategic Map Information – Likelihood of BMV Agricultural Land Dataset indicates that the site includes a significant proportion of BMV agricultural land. Land which is developed either for development of the airport or for surface access will effectively be permanently lost for agricultural use. The extent to which use of Greenfield or agricultural land has been minimised is not known. Greenfield (including agricultural land) is a finite resource, and its loss cannot be easily compensated through provision of land elsewhere. The loss of this land also means loss of value for food provision. The loss of 371 ha of agricultural land, at least half of which is likely to be BMV agricultural land, is a significant negative effect.

LHR-NWR

6.9.27 The use of large areas of previously undeveloped land will affect the quality of soil and land resources meaning these areas of land will no longer be suitable for other uses, including farming. In addition the loss of undeveloped soil through development, expansion has the potential to effect soil quality through erosion, contamination and degradation, which in turn may pose a risk to human health and to the environment.

6.9.28 During the construction phase, it is anticipated that risks to human health may arise if construction workers are exposed to soils or made ground affected by land contamination, particularly in areas of excavation, tunnelling, or levelling.

6.9.29 Dusts and odours may be produced during construction, particularly in association with the disturbance of historical landfill or industrial materials.

6.9.30 There is a potential to encounter previously unidentified underground structures. These may pose a risk to human and environmental receptors, particularly where these are proximate to areas where accumulation of ground gases is occurring.

6.9.31 Construction activities relating to piling, excavation and drainage have the potential to create pathways allowing contaminated materials to migrate to groundwater or surface water.

6.9.32 Hazardous substances may enter the environment as a result of spills and leaks associated with auxiliary activities including fuelling, de-icing, servicing and maintenance.

6.9.33 The off-site disposal of construction waste arising from demolition and enabling works could result in increased dust and vehicle emissions, with implications for human health, and potential surface water contamination from run-off or hazardous wastes or insufficient on-site storage facilities.

6.9.34 Development of land will affect soil resources (including physical loss of and damage to soil resources) associated with land contamination (from potential substance release) and structural damage (from potential compaction, burial, mixing, etc). Indirect impacts may also arise from changes in the local water regime, organic matter content, soil biodiversity, and soil process.

6.9.35 Development of agricultural land through airport development in conjunction with other infrastructure will have a cumulative effect on the availability of BMV agricultural land. Table 6-5 of the AoS Report provides a review of plans, policies, programmes and major infrastructure projects for cumulative effects. Potential cumulative effects on soils and agricultural land are identified with the National Networks National Policy Statement and Local Development Plans (Local Authorities of Runnymede District, Slough Borough, South Bucks District, Spelthorne Borough; London Boroughs of Ealing, Hammersmith and Fulham, Hounslow, Hillingdon, Richmond upon Thames and Royal Borough of Windsor and Maidenhead).

6.9.36 Mitigation will be incorporated within design, including best practice construction measures which will reduce the potential for contamination or loss of soil resources through contamination. It is anticipated that best practice measures, which will be set out at detailed design, will avoid the creation of pathways to other sensitive environmental features. These will ensure that any potential negative effects associated with contamination or degradation of soil resources are not significant.

6.9.37 The airport expansion site will require land take of 569 ha, with up to further 294 ha potentially affected by surface access and 43 ha identified for flood storage.[32]

6.9.38 The site area of the airport incorporates approximately 431 ha of agricultural land. Agricultural land is a finite and irreplaceable resource. ALCs Grade 1, 2 and 3a are the most productive uses, and are protected as BMV land. Natural England's Strategic Map Information – Likelihood of BMV Agricultural Land Dataset indicates that the site includes a high proportion of BMV agricultural land.

6.9.39 Land which is developed either for development of the airport or for surface access will effectively be permanently lost for agricultural use. The extent to which use of Greenfield or agricultural land has been minimised is not known. Greenfield (including agricultural land) is a finite resource, and its loss cannot be easily compensated through provision of land elsewhere. The loss of this land also means loss of value for food provision. The loss of 431 ha of agricultural land, at least half of which is likely to be BMV agricultural land, is a significant negative effect.

[32] Jacobs, 2014. *10. Place: Assessment,* p. ii. [online] Accessed 24/12/2015.

Objective 9: To protect sites designated for geodiversity

Question 15: Will it preserve, protect and improve geodiversity?

SEA Criteria	LGW-2R	LHR-ENR	LHR-NWR
Description of Impact (including effects on receptor)	A review of sites which are designated for geodiversity reasons, including geological SSSIs and RIGS has been undertaken. Newdigate (North) RIGS is situated 5 km to the northwest of London Gatwick Airport. No impacts on the RIGS in relation to loss of tranquillity from noise, direct land take, air quality effects on exposed geology, and contamination are anticipated.	A review of sites which are designated for geodiversity reasons, including geological SSSIs and RIGS has been undertaken. No Geological SSSIs or RIGS were identified within this radius. No impacts on geodiversity are anticipated.	A review of sites which are designated for geodiversity reasons, including geological SSSIs and RIGS has been undertaken. No Geological SSSIs or RIGS were identified within this radius. No impacts on geodiversity are anticipated.
Direct/ Indirect/ Cumulative	**N/A – no impact**	**N/A – no impact**	**N/A – no impact**
Probability (High, Medium, Low, Very Low)	**High** No Geological SSSIs or RIGS will be affected by the proposed development.	**High** No Geological SSSIs or RIGS will be affected by the proposed development.	**High** No Geological SSSIs or RIGS will be affected by the proposed development.
Phase, Duration (Long-term, Medium-term Short-term), Frequency	**N/A**	**N/A**	**N/A**
Permanent/ Temporary **Irreversible/ Reversible**	**N/A**	**N/A**	**N/A**
Magnitude and Spatial Extent (including transboundary)	**N/A**	**N/A**	**N/A**
Assumptions and Limitations	The search for Geological SSSIs and RIGS was confined to a 5 km buffer zone around the proposed airport expansion site.	The search for Geological SSSIs and RIGS was confined to a 5 km buffer zone around the proposed airport expansion site.	The search for Geological SSSIs and RIGS was confined to a 5 km buffer zone around the proposed airport expansion site.
Significance	**Neutral effect (0)** The proposal is unlikely to alter baseline conditions.	**Neutral effect (0)** The proposal is unlikely to alter baseline conditions.	**Neutral effect (0)** The proposal is unlikely to alter baseline conditions.

Objective 10: To minimise loss of undeveloped soils and of best and most versatile agricultural land, and protect soil against erosion, contamination and degradation

Question 16: Will It Maximise Construction On Previously Developed Land, Minimise Use Of Greenfield And Best And Most Versatile Agricultural Land?

SEA Criteria	LGW-2R	LHR-ENR	LHR-NWR
Description of Impact (including effects on receptor)	This scheme entails land take of 624 ha, with up to further 78 ha potentially affected by surface access.[33] The site area of the airport incorporates approximately 421 ha of agricultural land, a proportion of which is likely to be BMV agricultural land. Agricultural land is a finite and irreplaceable resource, and although compensation will be provided to land owners, the loss of the land cannot be mitigated. As a consequence of the site location, a high proportion of the land take required is from agricultural land, the quantity of PDL should be considered a correspondingly small proportion.	This scheme entails land take of 336 ha, with a further 330 ha potentially affected by surface access and 57 ha identified for flood storage.[34] The site area of the airport incorporates approximately 371 ha of agricultural land, a proportion of which is likely to be BMV agricultural land. Agricultural land is a finite and irreplaceable resource, and although compensation will be provided to land owners, the loss of the land cannot be mitigated. As a consequence of the site location, a high proportion of the land take required is from agricultural land, the quantity of PDL should be considered a correspondingly small proportion.	This scheme entails land take of 569 ha, with up to further 294 ha potentially affected by surface access and 43 ha identified for flood storage.[35] The site area of the airport incorporates approximately 431 ha of agricultural land, a proportion of which is likely to be BMV agricultural land. Agricultural land is a finite and irreplaceable resource, and although compensation will be provided to land owners, the loss of the land cannot be mitigated. As a consequence of the site location, a high proportion of the land take required is from agricultural land, the quantity of PDL- should be considered a correspondingly small proportion.
Direct/ Indirect/ Cumulative	**Direct, Cumulative** The impacts arise from direct land take. Development of agricultural land through airport development in conjunction with development taking place elsewhere in the vicinity of the airports will have a cumulative effect on the availability of BMV agricultural land.	**Direct, Cumulative** The impacts arise from direct land take. Development of agricultural land through airport development in conjunction with development taking place elsewhere in the vicinity of the airports will have a cumulative effect on the availability of BMV agricultural land.	**Direct, Cumulative** The impacts arise from direct land take. Development of agricultural land through airport development in conjunction with development taking place elsewhere in the vicinity of the airports will have a cumulative effect on the availability of BMV agricultural land.
Probability (High, Medium, Low, Very Low)	**High** These impacts are all certain to occur.	**High** These impacts are all certain to occur.	**High** These impacts are all certain to occur.
Phase, Duration (Long-term,	**Construction and Operation, Long-term** The potential impacts which have been	**Construction and Operation, Long-term** The potential impacts which have been	**Construction and Operation, Long-term** The potential impacts which have been

[33] Jacobs, 2014. *10. Place: Assessment,* pp. 16-18. [online] Accessed 24/12/2015.
[34] Jacobs, 2014. *10. Place: Assessment*, p. ii. [online] Accessed 24/12/2015.
[35] Jacobs, 2014. *10. Place: Assessment,* p. ii. [online] Accessed 24/12/2015.

SEA Criteria	LGW-2R	LHR-ENR	LHR-NWR
Medium-term Short-term), Frequency	identified occur both during construction and continuously during the operational life of the airport.	identified occur both during construction and continuously during the operational life of the airport.	identified occur both during construction and continuously during the operational life of the airport.
Permanent/ Temporary **Irreversible/ Reversible**	**Permanent, Irreversible** Greenfield (including agricultural land) is a finite resource, and its loss cannot be compensated through provision of land elsewhere. A strategy for increasing use of PDL as a strategy for further reducing loss of agricultural land could be substantiated at detailed design.	**Permanent, Irreversible** Agricultural land is a finite resource, and its loss cannot be compensated through provision of land elsewhere. A strategy for increasing use of PDL as a strategy for further reducing loss of agricultural land could be substantiated at detailed design.	**Permanent, Irreversible** Agricultural land is a finite resource, and its loss cannot be compensated through provision of land elsewhere. A strategy for increasing use of PDL as a strategy for further reducing loss of agricultural land could be substantiated at detailed design.
Magnitude and Spatial Extent (including transboundary)	**High, Local** Loss of BMV agricultural land would result in a high magnitude of effect, however, the effects of agricultural land lost will be experienced at a local level.	**High, Local** Loss of BMV agricultural land would result in a high magnitude of effect, however, the effects of agricultural land lost will be experienced at a local level.	**High, Local** Loss of BMV agricultural land would result in a high magnitude of effect, however, the effects of agricultural land lost will be experienced at a local level.
Assumptions and Limitations	It is not possible to quantity the precise proportion of BMV agricultural land to be lost through development at this stage of design. The extent to which the design has limited use of greenfield land and maximised use of PDL is not known.	It is not possible to quantity the precise proportion of BMV agricultural land to be lost through development at this stage of design. The extent to which the design has limited use of greenfield land and maximised use of PDL is not known.	It is not possible to quantity the precise proportion of BMV agricultural land to be lost through development at this stage of design. The extent to which the design has limited use of greenfield land and maximised use of PDL is not known.
Significance	**Significant Negative effect (--)**	**Significant Negative effect (--)**	**Significant Negative effect (--)**
	Direct loss of 421 ha agricultural land and additional greenfield land; high probability; occurs during construction but long term through operation; permanent and irreversible; high magnitude and local extent.	Direct loss of 371 ha agricultural land and additional greenfield land; high probability; occurs during construction but long term through operation; permanent and irreversible; high magnitude and local extent.	Direct loss of 431 ha agricultural land and additional greenfield land; high probability; occurs during construction but long term through operation; permanent and irreversible; high magnitude and local extent.

Question 17: Will it lead to the disturbing, harm, contamination or loss of soil resources?

SEA Criteria	LGW-2R	LHR-ENR	LHR-NWR
Description of Impact (including effects on receptor)	Development may result in soil loss or burial, physical damage including compaction, sealing, and structural damage, changes to soil water regime, effects on organic matter and soil stripping and storage. In addition, development has the potential to result in contamination of soil, resulting in risks to human health or the environment. The use of large areas of previously undeveloped land will affect the quality of soil and land resources meaning these areas of land will no longer be suitable for other uses, including farming.	Development may result in soil loss or burial, physical damage including compaction, sealing, and structural damage, changes to soil water regime, effects on organic matter and soil stripping and storage. In addition, development has the potential to result in contamination of soil, resulting in risks to human health or the environment. The use of large areas of previously undeveloped land will affect the quality of soil and land resources meaning these areas of land will no longer be suitable for other uses, including farming.	Development may result in soil loss or burial, physical damage including compaction, sealing, and structural damage, changes to soil water regime, effects on organic matter and soil stripping and storage. In addition, development has the potential to result in contamination of soil, resulting in risks to human health or the environment. The use of large areas of previously undeveloped land will affect the quality of soil and land resources meaning these areas of land will no longer be suitable for other uses, including farming.
Direct/ Indirect/ Cumulative	**Direct, Indirect, Cumulative** The potential impacts arising from contamination are both Direct, where associated with contamination or loss of soil resources, and Indirect, where associated within potential impacts from remobilisation of existing contamination or the creation of new migratory pathways. Construction for this project will be on-going concurrently with other major infrastructure development elsewhere in the UK, such as HS2, Crossrail 2. Potential cumulative effects with these projects are as follows: → pressure on the landfill/ waste disposal sites for multiple streams of contaminated materials; → potential for pathways for contaminated materials to affect sensitive environmental features, including groundwater and surface water. → physical loss or damage to local or national soil resources.	**Direct, Indirect, Cumulative** The potential impacts arising from contamination are both Direct, where associated with contamination or loss of soil resources, and Indirect, where associated within potential impacts from remobilisation of existing contamination or the creation of new migratory pathways. Construction for this project will be on-going concurrently with other major infrastructure development elsewhere in the UK, such as HS2, Crossrail 2. Potential cumulative effects with these projects are as follows: → pressure on the landfill/ waste disposal sites for multiple streams of contaminated materials; → potential for pathways for contaminated materials to affect sensitive environmental features, including groundwater and surface water. → physical loss or damage to local or national soil resources.	**Direct, Indirect, Cumulative** The potential impacts arising from contamination are both Direct, where associated with contamination or loss of soil resources, and Indirect, where associated within potential impacts from remobilisation of existing contamination or the creation of new migratory pathways. Construction for this project will be on-going concurrently with other major infrastructure development elsewhere in the UK, such as HS2, Crossrail 2. Potential cumulative effects with these projects are as follows: → pressure on the landfill/ waste disposal sites for multiple streams of contaminated materials; → potential for pathways for contaminated materials to affect sensitive environmental features, including groundwater and surface water. → physical loss or damage to local or national soil resources.

SEA Criteria	LGW-2R	LHR-ENR	LHR-NWR
Probability (High, Medium, Low, Very Low)	**High (Loss of soil resources) and Low (Contamination)** Physical damage to soil resources will occur through development, and could not be avoided or mitigated. Mitigation will be incorporated within design, and best practice construction measures which will reduce the potential for contamination or loss of soil resources through contamination. A major infrastructure project of this nature is likely to involve large scale soil movements due to cut and fill of materials; as a consequence it would not be possible to completely eliminate risk to human health from exposure to contaminated material, or creation of pathways for contaminated materials to migrate to sensitive groundwater or surface water resources.	**High (Loss of soil resources) and Low (Contamination)** Physical damage to soil resources will occur through development, and could not be avoided or mitigated. Mitigation will be incorporated within design, and best practice construction measures which will reduce the potential for contamination or loss of soil resources through contamination. A major infrastructure projects of this nature is likely to involve large scale soil movements due to cut and fill of materials, as a consequence it would not be possible to completely eliminate risk to human health from exposure to contaminated material, or creation of pathways for contaminated materials to migrate to sensitive groundwater or surface water resources.	**High (Loss of soil resources) and Low (Contamination)** Physical damage to soil resources will occur through development, and could not be avoided or mitigated. Mitigation will be incorporated within design, and best practice construction measures which will reduce the potential for contamination or loss of soil resources through contamination. A major infrastructure projects of this nature is likely to involve large scale soil movements due to cut and fill of materials, as a consequence it would not be possible to completely eliminate risk to human health from exposure to contaminated material, or creation of pathways for contaminated materials to migrate to sensitive groundwater or surface water resources.
Phase, Duration (Long-term, Medium-term Short-term), Frequency	**Construction and Operation, Long-term, Intermittent (contamination)** The potential contamination impacts which have been identified occur both during construction and during the operational life of the airport. However, it is anticipated that any negative effects would be intermittent. Physical damage to soils would be permanent.	**Construction and Operation, Long-term, Intermittent (contamination)** The potential contamination impacts which have been identified occur both during construction and during the operational life of the airport. However, it is anticipated that any negative effects would be intermittent. Physical damage to soils would be permanent.	**Construction and Operation, Long-term, Intermittent (contamination)** The potential contamination impacts which have been identified occur both during construction and during the operational life of the airport. However, it is anticipated that any negative effects would be intermittent. Physical damage to soils would be permanent.
Permanent/ Temporary **Irreversible/ Reversible**	**Permanent and Temporary/ Irreversible and Reversible** Physical damage to soils such as changes to structural damage and subsoil compaction is often long term and not reversible even when appropriate mitigation is applied. Best practice measures will ensure that any new potential for contamination will be identified, and appropriate measures will avoid the creation of pathways to other sensitive environmental features. Appropriate mitigation will be carried out to	**Permanent and Temporary/ Irreversible and Reversible** Physical damage to soils such as changes to structural damage and subsoil compaction is often long term and not reversible even when appropriate mitigation is applied. Best practice measures will ensure that any new potential for contamination will be identified, and appropriate measures will avoid the creation of pathways to other sensitive environmental features. Appropriate mitigation will be carried out to	**Permanent and Temporary/ Irreversible and Reversible** Physical damage to soils such as changes to structural damage and subsoil compaction is often long term and not reversible even when appropriate mitigation is applied. Best practice measures will ensure that any new potential for contamination will be identified, and appropriate measures will avoid the creation of pathways to other sensitive environmental features. Appropriate mitigation will be carried out to

SEA Criteria	LGW-2R	LHR-ENR	LHR-NWR
	prevent new contamination events.	prevent new contamination events.	prevent new contamination events.
Magnitude and Spatial Extent (including transboundary)	**Low, Local** The potential impacts are likely to be local. Best practice measures will be adhered to during construction and operation.	**Low, Local** The potential impacts are likely to be local. Best practice measures will be adhered to during construction and operation.	**Low, Local** The potential impacts are likely to be local. Best practice measures will be adhered to during construction and operation.
Assumptions and Limitations	Impact on soils is based on calculations undertaken by the AC. Soil impacts and mitigation measures for contamination would require further detailed surveys and assessments.	Impact on soils is based on calculations undertaken by the AC. Soil impacts and mitigation measures for contamination would require further detailed surveys and assessments.	Impact on soils is based on calculations undertaken by the AC. Soil impacts and mitigation measures for contamination would require further detailed surveys and assessments.
Significance	**Negative effect (-)**	**Negative effect (-)**	**Negative effect (-)**
	Direct and indirect effects on soil resources including loss, damage, and contamination; high probability of impacts on soil resources, low probability of contamination due to mitigation measures likely to be adopted; occurs during construction and operation; long-term and intermittent; effects are temporary and reversible; low magnitude and local in extent.	Direct and indirect effects on soil resources including loss, damage, and contamination; high probability of impacts on soil resources, low probability of contamination due to mitigation measures likely to be adopted; occurs during construction and operation; long-term and intermittent; effects are temporary and reversible; low magnitude and local in extent.	Direct and indirect effects on soils including loss, damage and contamination; high probability of impacts on soil resources, low probability of contamination due to mitigation measures likely to be adopted; occurs during construction and operation; long-term and intermittent; effects are temporary and reversible; low magnitude and local in extent.

6.10 MITIGATION

6.10.1 There are a number of good practice measures which can be used for all schemes. The effects on agricultural use can be partially mitigated during the construction phase, but no mitigation is possible for the permanent loss of agricultural land. As a consequence of the site locations of all schemes, a high proportion of the land take required is from agricultural land, and a low proportion is from PDL. The loss of agricultural land would typically be financially compensated for rather than mitigated against, though in some cases land uses may be relocated to alternative sites.

6.10.2 Further Agricultural Impact Assessment surveys could be required at a later stage to determine the value of agricultural land, and to identify BMV agricultural land in accordance with the guidelines and criteria for grading the quality of agricultural land.[36] This could feed into a strategy to provide mitigation or compensation for this loss. However, it is acknowledged that financial compensation will not mitigate the loss of the resource. Use of best practice means that agricultural and Greenfield land take for temporary use during construction would be minimised wherever possible. A strategy for further increasing use of PDL as a means of minimising loss of agricultural land could be substantiated at detailed design.

6.10.3 The ecosystem services approach can also be used to consider the environment in terms of the benefits it brings to people, including food production. This approach was used by the AC[37] but could be further developed during design to inform mitigation.

6.10.4 The results of the Phase II Ground Investigations will generate data to support risk assessment and mitigation measures to minimise the potential for the contamination of soil and land resources.

6.10.5 The Construction Code of Practice for Sustainable Use of Soils on Construction Sites provides guidance on good practice in soil handling as part of a Materials Management Plan. Soil management practices which can be applied include:

- Production of a Soil Management Plan based on a Soil Resource Survey Soil data. This data should be collected in conjunction with the agricultural impact assessment survey;
- Avoidance of traffic in areas that do not need to be disturbed;
- Careful stripping of top soils and subsoils (using suitable soil-handling equipment) from areas to be disturbed, ensuring no mixing with the subsoils when soil and weather conditions are suitable;
- Storing soils in temporary low stockpiles, protected from contamination by other materials and sown with grass if being stored for more than 6 months;
- Spreading top soils only on to subsoil that has been de-compacted; when soil and weather conditions are suitable; and,
- Re-use of surplus soils offsite including with the potential to improve conditions on local reclamation or brownfield developments sites.

6.10.6 General mitigation practices and principles that could apply to any or all phases of the project include:

- Use dust abatement techniques on unpaved, vegetated surfaces to minimize windblown erosion;

[36] Ministry of Agriculture Fisheries and Food, 1988. Agr*icultural Land Classification in England and Wales. Revised guidelines and criteria for grading the quality of agricultural land*. [online] Accessed 04/01/2017

[37] Jacobs, 2014. *7. Biodiversity Ecosystem Services* [online] Accessed 24/12/2015.

- Provide temporary stabilization of disturbed areas that are not actively under construction;
- Apply erosion controls (eg jute netting, silt fences, and check dams) to prevent/minimize soil erosion from vehicular traffic and during construction activities;
- Maintain vegetative cover within road rights-of-way (RoWs) to prevent erosion and periodically monitor ROWs to assess erosion;
- Clean and maintain catch basins, drainage ditches, and culverts regularly;
- During all phases of the project, keep equipment and vehicles within the limits of the initially disturbed areas;
- Conduct routine site inspections to assess the effectiveness of and the maintenance requirements for erosion and sediment control systems;
- Any soil arisings that have visual or olfactory evidence of contamination should be stored on a bunded sheeted stockpile on hardstanding or in a covered skip;
- If shallow groundwater is encountered during the earthworks, suitable consideration should be given for the storage and disposal of groundwater from any likely dewatering activities that may be required; and
- Suitable drainage design including the provision of filter drains, wetlands and detention ponds will provide a high degree of treatment to surface water runoff from the road prior to infiltration or discharge, in accordance with the recommendations of the Draft National Standards for Sustainable Drainage.

6.10.7 Measures can be put in place to prevent any contaminated material impacting on groundwater or surface water during construction, including segregation of contaminated material into areas where it cannot leach into water bodies/courses.[38]

6.11 ASSUMPTIONS AND LIMITATIONS

6.11.1 Loss of land is based on calculations undertaken by the AC based on scheme footprints and surface access.

6.11.2 Grade 1, 2 and 3a Agricultural Land is classified by planning policy as BMV Agricultural Land, and is protected as a natural resource.[39] Natural England's Likelihood of BMV Agricultural Land dataset that has been used is for strategic purposes, and so can only be considered to provide an approximate proportion of likely BMV Land. Further assessment will be required to classify the extent of effect on agricultural land, and this will form this basis for any compensation to be provided.

6.11.3 Risk assessments for contamination and further refinement of mitigation measures will be needed following the site investigations at the detailed design phase.

[38] Jacobs, 2014. *10. Place: Assessment*, p. 114. [online] Accessed 24/12/2015.
[39] Natural England, 2009. *Agricultural Land Classification: protecting the best and most versatile agricultural land* (TIN049.) [online] Accessed 24/12/2015.

6.12 CONCLUSIONS

6.12.1 As with any major infrastructure project potential effects on soils, contamination, and agriculture will arise during construction and operation. With regards to effects on soil quality, and contaminated land, the significance of the effects will depend on the effectiveness of mitigation which is carried out. Not all impacts can be effectively mitigated due to the scale and nature of the proposed development, particularly the loss of soils and BMV land.

Objective 9: To protect sites designated for geodiversity

6.12.2 No significant impacts on Geological SSSIs or RIGS are expected for any of the expansion schemes.

Objective 10: To minimise loss of undeveloped soils and of best and most versatile agricultural land, and protect soil against erosion, contamination and degradation

6.12.3 Greenfield (including agricultural land) is a finite resource, and its loss cannot be compensated through provision of land elsewhere. The following quantity of agricultural land would be lost for each scheme:

- → LGW-2R: 421 ha out of a total land take of 701 ha.
- → LHR-ENR: 371 ha out of a total land take of 724 ha.
- → LHR-NWR: 431 ha out of a total land take of 906 ha.

6.12.4 The loss of agricultural land would typically be financially compensated for rather than mitigated against. However, whilst it would be possible to compensate for the financial loss, this would not address the effects associated with this loss of resource for food provision and other benefits. Of the agricultural land lost, at least 50% of the Heathrow schemes, and up to 60% at Gatwick is likely to be BMV agricultural land.

6.12.5 All of the schemes would result in a significant negative effect on agricultural land due to the scale of irreversible loss. However, LHR-NWR has the greatest amount of land lost followed by LGW-2R and then LHR-ENR with least loss.

6.12.6 Construction and operational activities have the potential to pollute soils. Development of land will affect soil resources. Effects include physical loss of and damage to soil resources associated with land contamination from potential substance release and structural damage from potential compaction, burial, mixing, etc. Indirect impacts may also arise from changes in the local water regime, organic matter content, soil biodiversity and soil process.

6.12.7 Mitigation will be incorporated within design and best practice construction measures, which will reduce the potential for contamination or loss of soil resources through contamination. It is anticipated that best practice measures, which will be set out at detailed design, will avoid the creation of pathways to other sensitive environmental features. Potential effects associated with contamination or degradation of soil resources are considered negative.