Appendix B
Detailed Appraisal including Baseline and Contextual Information

Appendix B contains the collated contextual and baseline information along with the detailed findings of the appraisal of the draft NPS and reasonable alternatives for the following topics:

- B1: Biodiversity and Nature Conservation
- B2: Population, Economics and Skills
- B3: Human Health
- B4: Land Use, Geology and Soils
- B5: Water Quality
- B6: Flood Risk and Coastal Change
- B7: Air
- B8: Noise
- B9: Climatic Factors
- B10: Waste
- B11: Traffic and Transport
- B12: Cultural Heritage
- B13: Landscape and Townscape

Each topic chapter contains:

- A definition of the topic under consideration;
- A review of plans and programmes at international, UK and national (England, Scotland and Wales) scales;
- An overview of the baseline;
- A summary of the existing problems to be taken into account in carrying out the AoS;
- A description of the evolution of the baseline;
- The objectives and guide questions used in the appraisal of the draft NPS and reasonable alternatives to the NPS alongside definitions of significance; and
- Completed matrices that record the findings of the appraisal of the draft NPS and reasonable alternatives against the AoS objectives.

For the purposes of the review of the international plans and programmes for this AoS, it is assumed that the broad objectives of extant European Union (EU) legislation will be maintained once the UK has withdrawn from the EU and that similar or equivalent environmental protections will remain in place.

1. Biodiversity and Nature Conservation

Introduction

This section presents the overview of plans, programmes and baseline information for the appraisal of sustainability of the National Policy Statement for Geological Disposal Infrastructure and reasonable alternatives in respect of biodiversity and nature conservation.

Biodiversity in this context is defined by the **Convention on Biological Diversity**[1] as "*the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems*." Biodiversity is integral to the functioning of ecosystems and these, in turn, provide 'ecosystem services' which include food, flood management, pollination and the provision of clean air and water.

There are links between the biodiversity and nature conservation topic and other topics in the Appraisal of Sustainability (AoS), including water quality, land use, geology and soils, climate change and landscape and townscape.

Review of Plans and Programmes

The review of plans and programmes has identified that at the international/European level, a broad range of plans and programmes seek to protect biodiversity, including setting long-term goals to prevent the loss of biodiversity and various agreements to control the trade in endangered species. At the national level, the majority of plans and programmes seek to protect all valuable habitats and species. There is also a drive to support healthy, well-functioning ecosystems for the benefit of wildlife and people.

International/European

The UK is a signatory (along with another 167 parties) to the ***Convention on Biological Diversity (CBD)***, which entered into force in 1993. The main objectives of the Convention are the conservation of biological diversity and the sustainable and equitable use of biodiversity components. The CBD called for the development and enforcement of national strategies and associated action plans to identify, conserve and protect existing biological diversity, and to enhance it wherever possible.

In October 2010, the Convention on Biological Diversity Conference of Parties agreed the ***Strategic Plan for Biodiversity 2011-2020*** at Nagoya, Japan. With its five strategic goals and 20 new global 'Aichi' targets, the Plan sets a new global vision and direction for biodiversity. The new global vision is: "By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people." The parties also agreed a shorter-term ambition to "Take effective and urgent action to halt the loss of biodiversity, [so] that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication".

[1] The convention uses this definition to describe 'biological diversity' commonly taken to mean the same as biodiversity

The ***Nagoya Protocol on Access and Benefit-sharing***, which entered into force in 2014, is a supplementary agreement to the Convention on Biological Diversity which sets out to establish a fair and equitable system to enable nations to co-operate in accessing and sharing the benefits of genetic resources.

The UK is also party to the ***Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)***, which was ratified in the UK in 1985 and provides strict protection for endangered migratory species, and the ***Bern Convention on the Conservation of European Wildlife and Natural Habitats (1982)***, which aims to ensure the conservation and protection of species and their natural habitats. In addition, the UK is party to the ***Convention on International Trade in Endangered Species of Wild Fauna and Flora*** (CITES) which came into force in 1975. The convention aims to ensure that international trade in wild animals and plants does not threaten the survival of the species in the wild.

The European Commission adopted the ***EU Biodiversity Strategy to 2020*** in 2011 to help halt the loss of biodiversity in the EU. The Strategy provides a framework for action over the next decade and covers the following key areas:

- conserving and restoring nature;
- maintaining and enhancing ecosystems and their services;
- ensuring the sustainability of agriculture, forestry and fisheries;
- combating invasive alien species; and
- addressing the global biodiversity crisis.

The strategy also sets out the following 2050 vision and 2020 headline target:

- By 2050, EU biodiversity and the ecosystem services it provides - its natural capital - are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided; and
- Halt the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restore them insofar as is feasible, while stepping up the EU contribution to averting global biodiversity loss.

The EU's ***7th Environment Action Programme***, adopted in 2013, aims to accelerate the achievement of the strategy's objectives.

There are a number of EU Directives focusing on various types of wildlife and habitat that provide a framework for national action and international co-operation for conservation on land and in the sea. In particular, the ***Habitats Directive (92/43/EEC)*** and ***Birds Directive (2009/147/EC)*** include measures to maintain or restore important natural habitats and species including through the designation of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). These Directives are transposed into British law through a number of regulations and planning policy documents.

Under the ***Ramsar Convention***, wetlands of international importance are designated as Ramsar sites. As a matter of policy, Ramsar sites in the UK are protected as European sites. The vast majority are also classified as SPAs and all terrestrial Ramsar sites in England are notified as Sites of Special Scientific Interest (SSSIs).

The ***Water Framework Directive (WFD) (2000/60/EC)*** established a framework for the protection of inland surface waters, transitional waters, coastal water and groundwater and was designed to improve and integrate the way water bodies are managed, including encouraging the sustainable use of water resources. The key objectives at the European level include the general protection of the aquatic ecology and providing specific protection of unique and valuable habitats. The prevention of water deterioration is also a legally binding duty on Member States under the Directive.

The ***Marine Strategy Framework Directive (2008/56/EC)*** requires Member States to develop a marine strategy, including determining Good Environmental Status (GES) for their marine waters, and designing and implementing programmes of measures aimed at achieving it by 2020, using an ecosystem approach to marine management. It takes account both of socio-economic factors and the cost of taking action in relation to the scale of the risk to the marine environment.

UK

The Wildlife and Countryside Act (1981) is the main UK legislation relating to the protection of named animal and plant species and includes legislation relating to the UK network of nationally protected wildlife areas: Sites of Special Scientific Interest (SSSIs)[2]. Under this Act, Natural England has responsibility for identifying and protecting the SSSIs in England. The ***Countryside and Rights of Way Act 2000 (CROW Act)*** strengthens the powers of Natural England to protect and manage SSSIs. The CROW Act improves the legislation for protecting and managing SSSIs so that:

- Natural England can change existing SSSIs to take account of natural changes or new information;
- all public bodies have a duty to further the conservation and enhancement of SSSIs;
- neglected or mismanaged sites can be brought into favourable management; and
- offences and heavier penalties apply to people who illegally damage SSSIs.

The ***UK Biodiversity Action Plan (1994)*** was the UK Government's response to signing the CBD at the 1992 Rio Earth Summit. The UK Biodiversity Action Plan was then established to conserve and enhance biodiversity in the UK through the use of Habitats and Species Action Plans to help the most threatened species and habitats to recover and to contribute to the conservation of global biodiversity.

Following the creation of the UK BAP, devolution in 1998 led the four countries of the UK (England, Northern Ireland, Scotland and Wales) to develop their own country strategies for biodiversity and the environment, allowing conservation approaches to differ according to the different environments and priorities within the countries. In 2007, however, a shared vision for UK biodiversity conservation was adopted by the devolved administrations and the UK government, and is described in '***Conserving Biodiversity – the UK Approach***'. This document reflected the drivers for conservation action in the UK since the UK BAP was created, including the EU Gothenburg agreement in 2001 to halt the loss of biodiversity by 2010, and the findings of the Millennium Ecosystem Assessment (2005).

The ***UK Post-2010 Biodiversity Framework***, published in July 2012 by the Joint Nature Conservation Committee (JNCC) and Defra, succeeds the UK BAP and 'Conserving

[2] As amended by the Countryside and Rights of Way Act 2000 and the Natural Environment and Rural Communities Act 2006.

Biodiversity – the UK Approach', and is the result of a change in strategic thinking following the publication of the CBD's 'Strategic Plan for Biodiversity 2011–2020', and the launch of the EU Biodiversity Strategy.

The purpose of this UK Post-2010 Biodiversity Framework[3] is to set a broad enabling structure for action across the UK between now and 2020:

i. To set out a shared vision and priorities for UK-scale activities, in a framework jointly owned by the four countries, and to which their own strategies will contribute;

ii. To identify priority work at a UK level which will be needed to help deliver the Aichi targets and the EU Biodiversity Strategy;

iii. To facilitate the aggregation and collation of information on activity and outcomes across all countries of the UK, where the four countries agree this will bring benefits compared to individual country work; and

iv. To streamline governance arrangements for UK-scale activity.

The Framework demonstrates how the work of the four countries and the UK contributes to achieving the Aichi Biodiversity Targets, and identifies the activities required to complement the country biodiversity strategies in achieving the targets.

The ***Great Britain Invasive Non-native Species Strategy (2015)*** sets aims and objectives to 2020 to address invasive species, including the prevention of invasive species arriving in Britain, early detection and monitoring, eradication and control.

The ***Conservation of Habitats and Species Regulations 2017*** (SI 2017/1012) (in England and Wales), the ***Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)*** (in Scotland) and the ***Conservation (Natural Habitats) Regulations (Northern Ireland) 1995 (as amended)*** (NISR 1995/380) (in Northern Ireland) require that sites of importance to habitats or species are to be designated and any impact on such sites or species must be considered in regards to planning permission applications.

The ***Environmental Protection Act (1990)*** sets out key statutory requirements for the UK regarding environmental protection (including waste and nature conservation).

The Marine Strategy Framework Directive was transposed into UK law by the ***Marine Strategy Regulations 2010*** (SI 2010/1627) and sets out a requirement for Member States to:

- provide an assessment of the current state of their seas by July 2012;
- provide a set of detailed characteristics of what GES means for their waters, and associated targets and indicators, by July 2012;
- establish a monitoring programme to measure progress by July 2014; and
- establish a programme of measures for achieving GES by 2016.

The UK has set targets for a healthy marine environment by 2020 under this Directive. The strategy to do this was published in stages: with the first part published in 2012, the second part containing monitoring programmes in 2014, and the third part setting out the programme of measures was published in 2015.

[3] Joint Nature Conservancy Committee and Defra (2012) *UK Post-2010 Biodiversity Framework.* Available online at: http://jncc.defra.gov.uk/pdf/UK_Post2010_Bio-Fwork.pdf

The ***Marine and Coastal Access Act (2009)*** sets out a number of measures including the establishment of Marine Conservation Zones (MCZs) and Marine Spatial Plans.

The ***National Parks and Access to the Countryside Act (1949)*** aims to conserve and protect countryside and National Parks through legislation.

England

The ***Natural Environment and Rural Communities Act 2006*** established Natural England as the main body responsible for conserving, enhancing and managing England's natural environment. It also covers biodiversity, pesticides harmful to wildlife and the protection of birds.

The ***Natural Environment White Paper (Defra, 2011)*** recognises that nationally, the fragmentation of natural environments is driving continuing threats to biodiversity. It sets out the Government's policy intent to:

- improve the quality of the natural environment across England;
- move to a net gain in the value of nature;
- arrest the decline in habitats and species and the degradation of landscapes;
- protect priority habitats;
- safeguard vulnerable non-renewable resources for future generations;
- support natural systems to function more effectively in towns, in the country and at sea; and
- create an ecological network which is resilient to changing pressures.

By 2020, the Government seeks to achieve an overall improvement in the status of the UK's wildlife including no net loss of priority habitat and an increase of at least 200,000 hectares in the overall extent of priority habitats. Under the White Paper, the Government has also put in place a clear institutional framework to support nature restoration which includes Local Nature Partnerships creating new Nature Improvement Areas (NIAs).

Biodiversity 2020: A strategy for England's wildlife and ecosystem services (Defra, 2011) builds on the Natural Environment White Paper and provides a comprehensive picture of how the Government is implementing international and EU commitments. It sets out the strategic direction for biodiversity policy for the next decade on land (including rivers and lakes) and at sea. The Strategy has as its mission to halt overall biodiversity loss, support healthy, well-functioning ecosystems, and establish coherent ecological networks, with more and better places for nature for the benefit of wildlife and people.

The ***National Planning Policy Framework (NPPF) (Department for Communities and Local Government (DCLG), 2012)*** includes key policies to ensure the planning system contributes to and enhances the natural and local environment by:

- protecting and enhancing valued landscapes, geological conservation interests and soils;
- recognising the wider benefits of ecosystem services;
- minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures;

- 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.

The NPPF states that, when preparing plans to meet development needs, the aim should be to minimise pollution and other adverse effects on the local and natural environment. Local planning authorities are expected to set criteria based policies against which proposals for any development on or affecting protected wildlife or geodiversity or landscape areas will be judged. In doing so, they must take into account the policies in the NPPF including those which set out the circumstances where in order to conserve and enhance biodiversity planning permission should be refused.

Planning Practice Guidance for the Natural Environment (2016) explains key issues in implementing policy to protect biodiversity, including local requirements.

Scotland

The ***National Planning Framework 3 (2014)***, as part of its spatial strategy, envisions Scotland as "a natural and resilient place" and identifies where there will be opportunities for environmental enhancement.

The ***Nature Conservation (Scotland) Act 2004*** places duties on public bodies in relation to the conservation of biodiversity, increases protection for SSSI, amends legislation on Nature Conservation Orders, provides for Land Management Orders for SSSIs and associated land, strengthens wildlife enforcement legislation, and requires the preparation of a Scottish Fossil Code.

Scottish Planning Policy (SPP) (2014) sets out the Scottish Government's policy on land use planning. It incorporates the conservation of designated or protected sites and species, takes into account ecosystems and natural processes and seeks to establish integrated habitat networks.

Planning Advice Note 60 (PAN 60): Planning for Natural Heritage (2000) provides advice on how development and the planning system can contribute to the conservation, enhancement, enjoyment and understanding of Scotland's natural environment and encourages developers and planning authorities to be positive and creative in addressing natural heritage issues.

Scotland's Biodiversity: It's in Your Hands - A strategy for the conservation and enhancement of biodiversity in Scotland (2004) aims to conserve biodiversity for the health, enjoyment and wellbeing of the people of Scotland now and in the future and provides a 25 year framework in order to achieve this goal. ***Scotland's performance against 2010 international targets*** showed that good progress had been made towards meeting the UN target of a significant reduction in the loss of biodiversity. Lessons learnt from the 2010 assessment included the need to adopt a more adaptive approach, learning from experience and trying to tackle the causes of biodiversity loss. The ***2020 Challenge for Scotland's Biodiversity (2013)*** is a supplement to Scotland's Biodiversity: It's in Your Hands, and together, the two documents comprise the ***Scottish Biodiversity Strategy***. The 2020 Challenge focusses on desired outcomes for 2020, responds to the new international Aichi targets and updates elements of the 2004 strategy.

Scotland's Biodiversity - a Route Map to 2020 (2015) sets out the short-term priority work needed to deliver the 2020 Challenge and meet the international Aichi Targets for biodiversity.

Progress against the 2020 challenge for biodiversity was most recently presented to the Scottish Parliament in the ***Scottish Biodiversity Strategy: Report to the Scottish Parliament 2014 – 2016***[4].

The first land use strategy for Scotland (***Getting the best from our land - A land use strategy for Scotland) (2011)***) had the objectives of: land-based businesses working with nature; responsible stewardship of Scotland's natural resources; and urban and rural communities better connected to the land. The vision, objectives and principles of the strategy were retained and built upon by the second land use strategy (published 2016) which covers the period 2016 – 2021.

Wales

Planning Policy Wales (Edition 8) (2016) sets out the land use planning policies of the Welsh Government, including objectives for the conservation and improvement of landscape and biodiversity.

Technical Advice Note 5 (TAN5): Nature Conservation and Planning (2009) sets out how the planning system should contribute to protecting and enhancing biodiversity and geological conservation.

The ***Environment Strategy for Wales*** was published in May 2006. It set out proposed outcomes for what the Welsh Government sought to achieve by 2026, and the actions required. The ***One Wales: One Planet (2009)*** sustainable development scheme also supports the strategy's outcomes and includes biodiversity indicators.

The ***Well-being of Future Generations (Wales) Act 2015*** sets out a framework to improve the social, economic, environmental and cultural well-being of Wales. It requires public bodies in Wales to contribute to sustainable development and in particular to implement actions that contribute to well-being goals established under the Act. One goal, "a resilient Wales" refers explicitly to biodiversity, "A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change)".

The ***Environment (Wales) Act 2016*** sets a more joined up legislative framework for regulating Wales' environment, and provides for the sustainable management of natural resources. It required Welsh Ministers to adopt a ***Natural Resources Policy*** (NRP), which was published in August 2017. The focus of the NRP is the sustainable management of Wales' natural resources to maximise their contribution to achieving goals within the Well-being of Future Generations Act 2015. The policy sets out three National Priorities. These are: delivering nature-based solutions; increasing renewable energy and resource efficiency; and taking a place-based approach. The NRP links to the Wales National Marine Plan as the means of sustainably managing marine resources, reflecting the context of the ecosystem approach for Wales' marine area.

The Environment (Wales) Act 2016 required Natural Resources Wales to publish a ***State of Natural Resources Report*** (SoNaRR) which set out evidence on Wales' progress towards its environment and natural resource management goals, which was published in 2016. The Act also establishes a duty on public authorities to "maintain and enhance biodiversity in the exercise of functions in relation to Wales, and in so doing promote the resilience of ecosystems".

[4] Scottish Government (2017) *Scottish Biodiversity Strategy: Report to the Scottish Parliament 2014 – 2016*. Available online at: http://www.gov.scot/Resource/0052/00522533.pdf

Overview of the Baseline

Good quality habitats are those which, for a given habitat type, have a larger range of features. For example, a habitat that has varying topography, water distribution or appropriate grazing by animals. This provides a broader variety of conditions and resources that a greater number and diversity of species can exploit. A good quality habitat needs to be large enough to support populations of species over a long period of time. Additionally, some species require large areas of consistent habitat, whilst others thrive in mosaics and therefore the best sites need to be of a size that allows both species to be accommodated.

A mixture or mosaic of habitats provide areas for a variety of species that require different conditions and resources to survive. Having multiple habitats in a locality provides opportunity for a higher number of species to utilize and occupy the area. Therefore, biodiversity is generally higher.

Habitat and habitat quality are therefore commonly used as indicators of biodiversity as good quality, diverse habitats with consistent resources and conditions generally allow for a greater diversity of species to survive and reproduce.

The baseline data presented in this section takes a comprehensive look at the overall national baseline for biodiversity. The relationship between the baseline environment and the potential effects of the plan will become increasingly clear as the appraisal progresses. Inevitably this means that in some instances the link between the baseline environment discussed here and the NPS are not directly clear; however the baseline environmental information is included to ensure that the appraisal is based on a comprehensive dataset from the outset.

UK

Special Areas of Conservation (SACs), Sites of Community Importance (SCIs), Special Protection Areas (SPAs) and Ramsar sites are important for biodiversity at the international level. In the UK there are 651 SACs/SCIs, 272 SPAs and 149 Ramsar sites[5].

Figures 1.1, 1.2 and 1.3 illustrate the distribution of European designed sites in England, Scotland and Wales. In addition, there are almost 7,000 nationally designated sites in the UK, known as SSSIs in England, Wales and Scotland, and Areas of Special Scientific Interest (ASSIs) in Northern Ireland. There are currently 105 SACs with marine component, covering approximately 14% of UK marine waters. 80 of these SACs are completely in inshore waters. There currently are 13 marine habitats and eight marine species in UK waters which are protected under Annexes I and II of the Habitats Directive[6].

[5] Joint Nature Conservation Committee (2017) *UK Protected Sites*. Available online at: http://jncc.defra.gov.uk/page-4
[6] Joint Nature Conservation Committee (2017) *SACs with Marine Components*. Available online at: http://jncc.defra.gov.uk/page-1445

Figure 1.1 Location of Special Areas of Conservation (SACs) in the UK

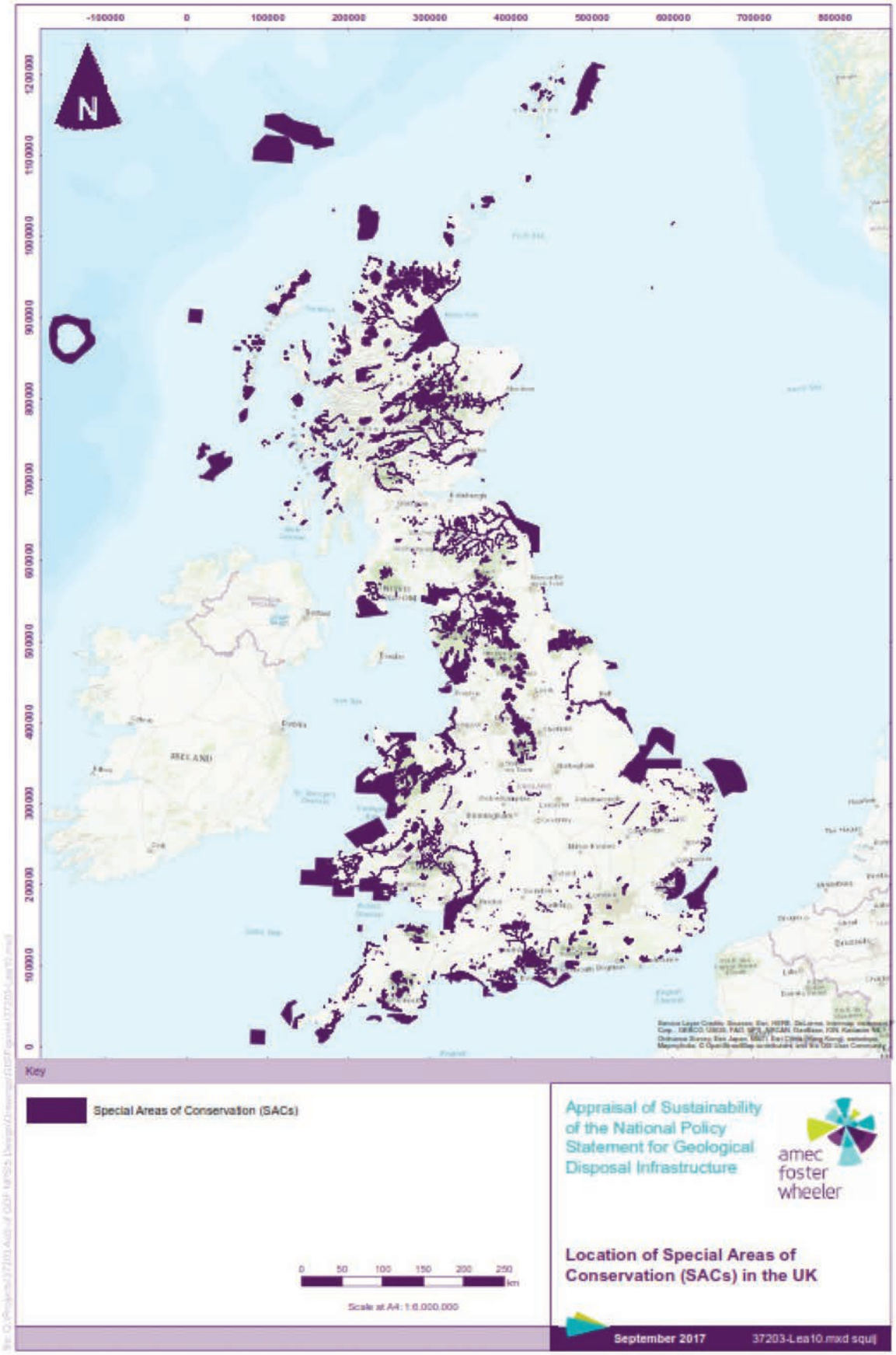


Figure 1.2 Location of Special Protection Areas (SPA) in the UK

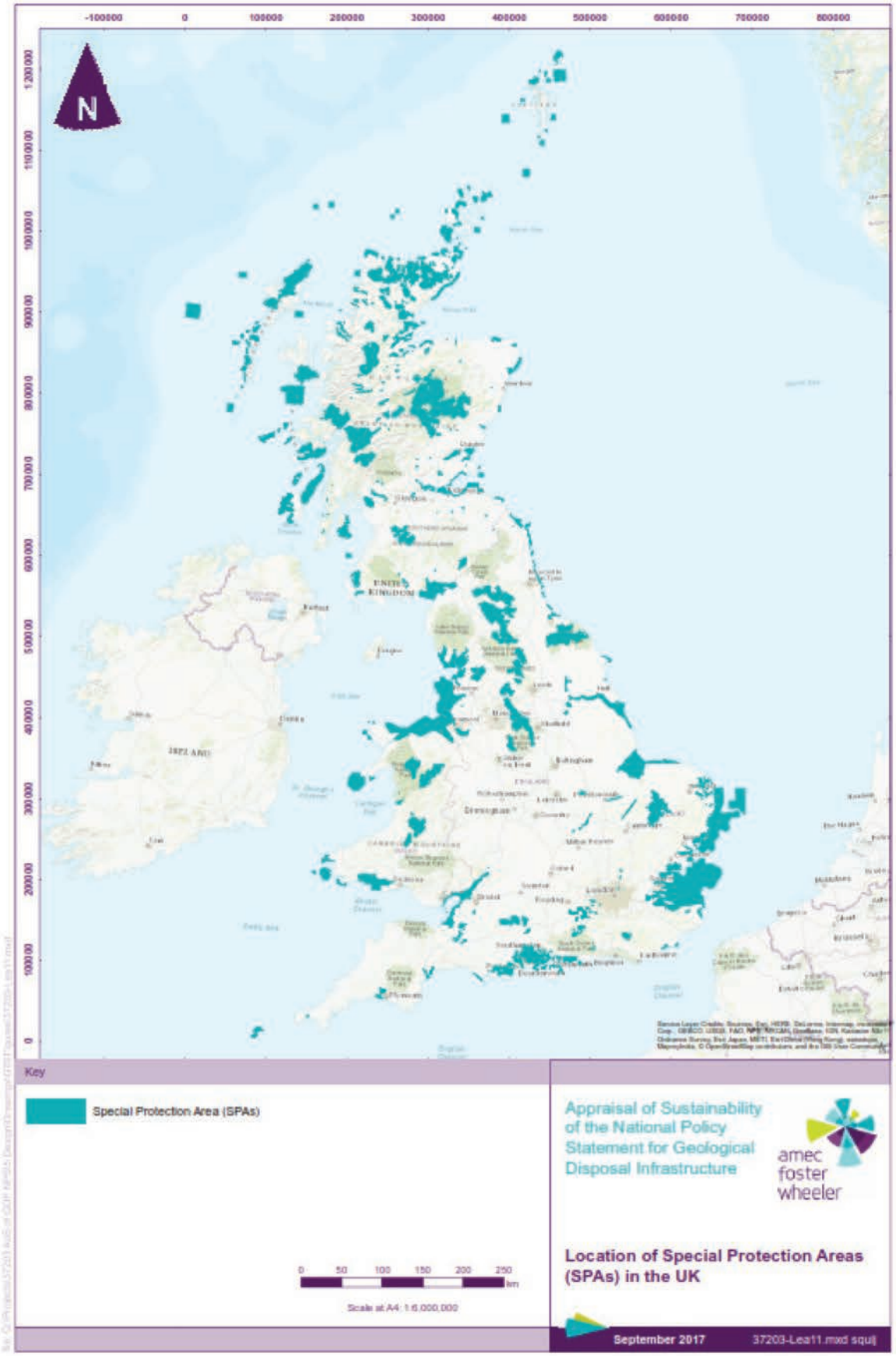
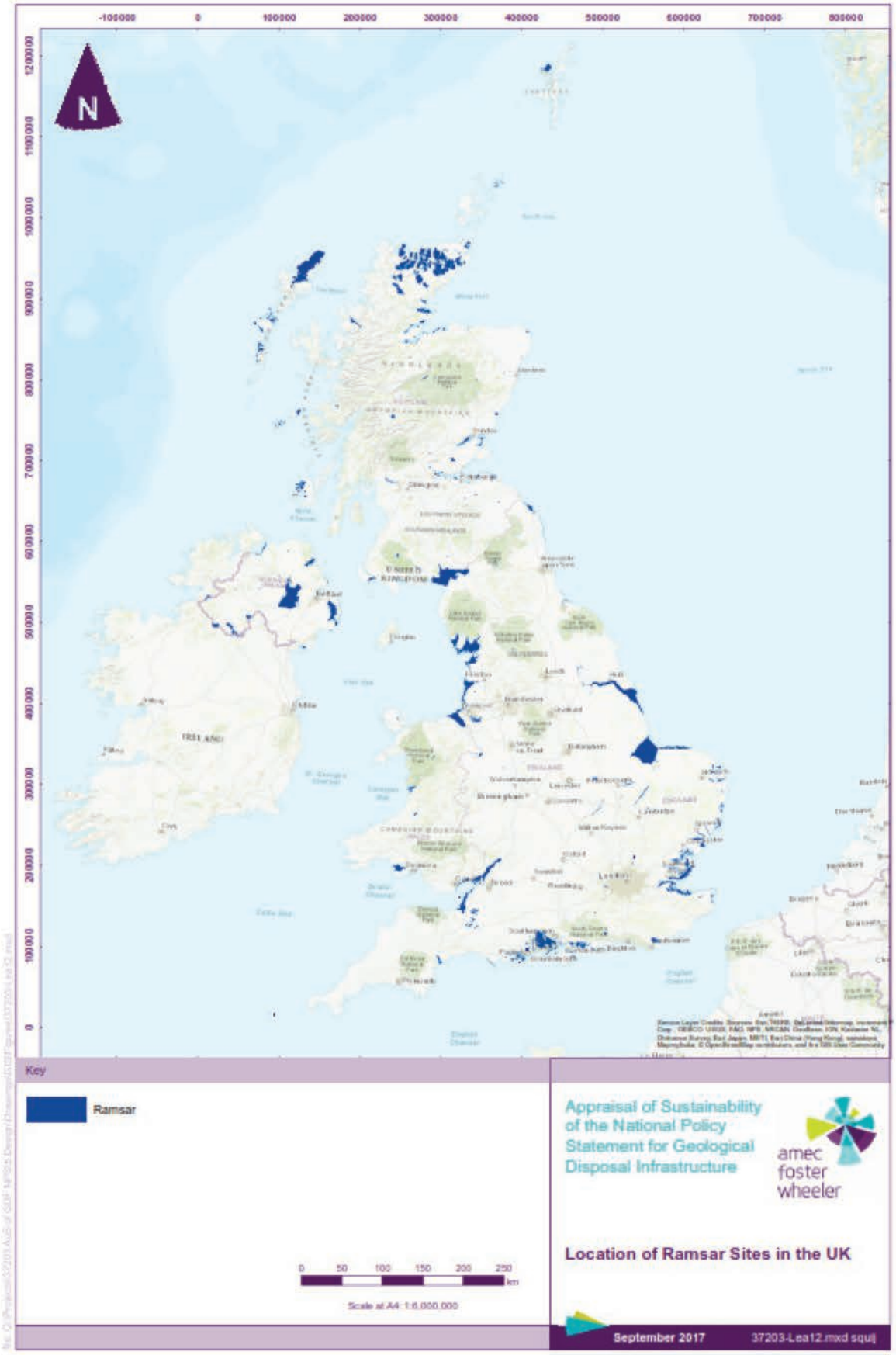


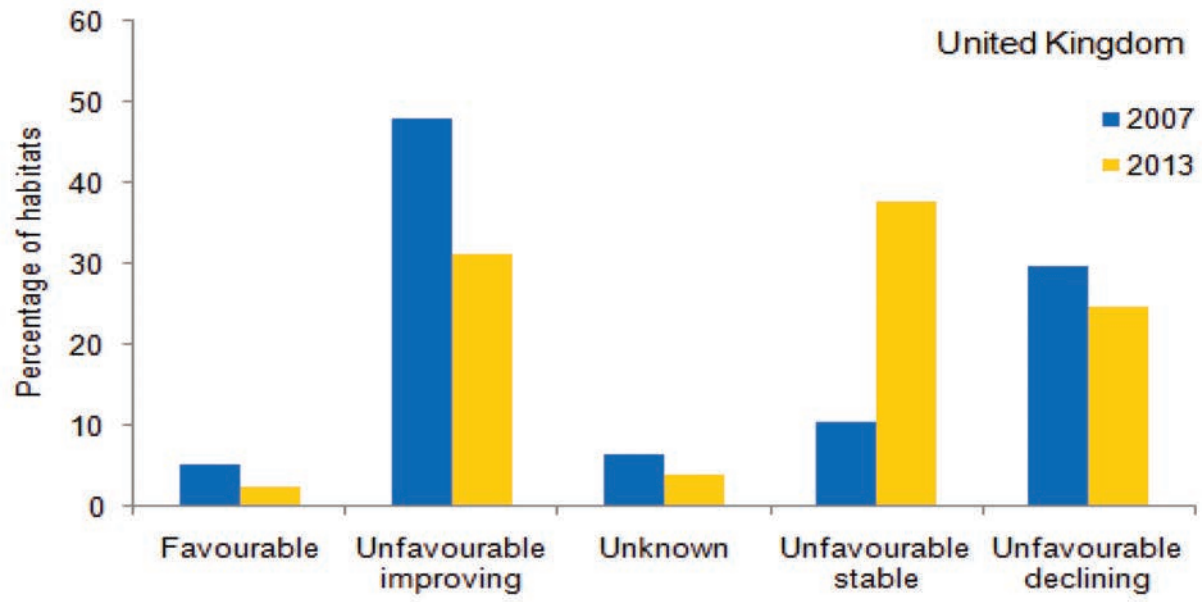
Figure 1.3 Location of Ramsar Sites in the UK



Conservation Status of UK Habitats Listed under the Habitats Directive

In 2007 and again in 2013, the Joint Nature Conservation Committee (JNCC) published reports identifying the change in status of UK habitats of European importance [7]. The 2007 Report identified that 5% of UK habitats listed in Annex I of the Habitats Directive were in favourable conservation status, with that number declining to 3% in the 2013 report. The conservation status of 48% of habitats was improving in 2007, while in 2013, 31% were found to be improving. The conservation status of 30% of the habitats was declining in 2007, whereas in 2013 only 25% were declining (see **Figure 1.4**).

Figure 1.4 Percentage of UK habitats of European importance in improving or declining conservation status in 2007 and 2013.



Source: UK Habitats Directive (Article 17) reports: 2nd UK Report on Implementation of the Habitats Directive (2007) and 3rd UK Habitats Directive Reporting (2013).

Note: Graph based on 77 habitats listed on Annex I of the Habitats Directive.
The aim of the Habitats Directive is to achieve favourable conservation status for the species and habitats listed in its Annexes. An assessment of status and trends for each species and habitat is undertaken every six years. Trends in unfavourable conservation status allow identification of whether progress is being made, as it will take many years for some habitats and species to reach favourable conservation status.

UK Post-2010 Biodiversity Framework

The UK Post-2010 Biodiversity Framework, published in July 2012, succeeded the UK Biodiversity Action Plan (BAP). Much of the work previously carried out under the UK BAP is now focused at a country level, however, the UK BAP lists of priority species and habitats remain important reference sources and were used to draw up statutory lists of priorities in

[7] UK Habitats Directive (Article 17) reports: 2nd UK Report on Implementation of the Habitats Directive (2007) and 3rd UK Habitats Directive Reporting (2013)

England, Scotland and Wales. The most recent set of reports on BAP priority species and habitats was released in 2010[8], and identified the following key findings:

- 8 priority habitats (18%) and 40 priority species (11%) were increasing or probably increasing;
- 9 priority habitats (20%) and 144 priority species (39%) were stable or probably stable;
- 19 priority habitats (42%) and 88 priority species (24%) were declining or probably declining, but the rate of decline was slowing for 9 habitats (20%) and 28 species (8%); and
- 8 species were reported to have been lost since the publication of the UK BAP in 1994.

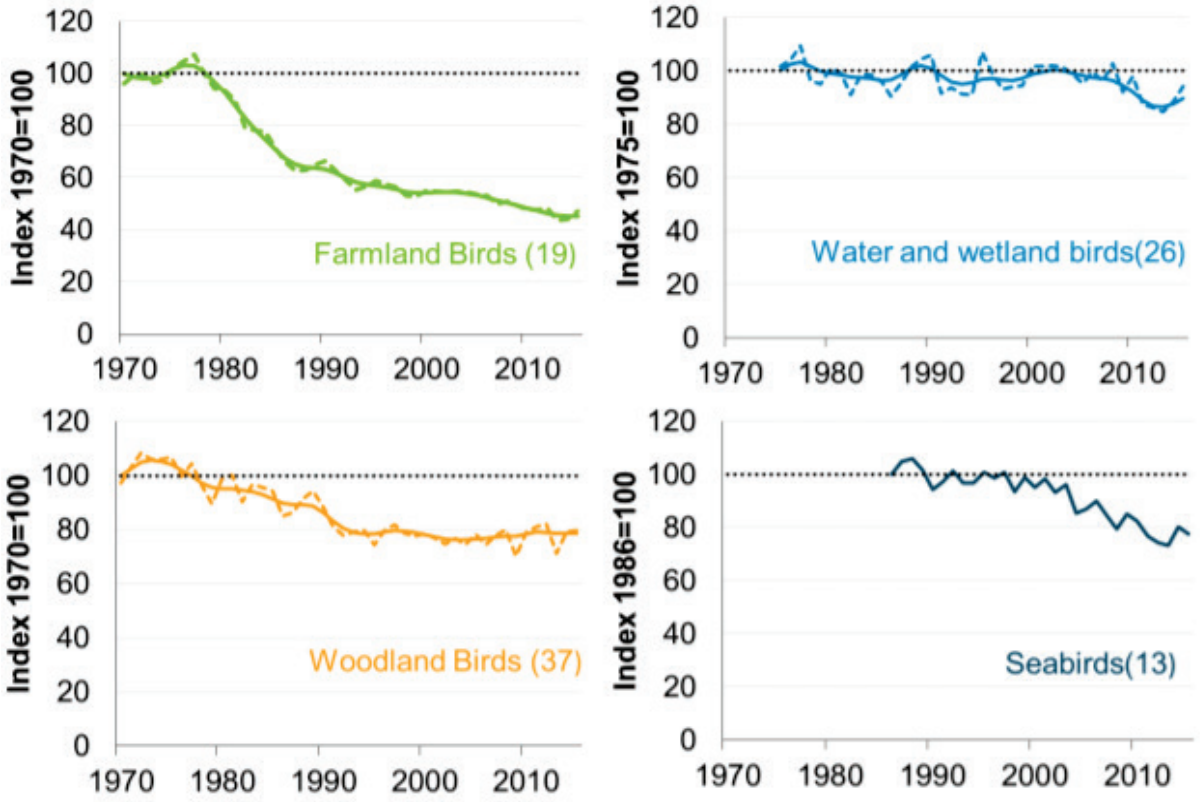
Bird Populations

Bird populations are considered to be good indicators of the state of the environment and the countryside. Species typical of farmland, woodland and coastal areas have been used as indicators of the health of their particular habitat (see **Figure 1.5** and **Figure 1.6** which provide an overview of population changes since 1970)[9]. The species used to calculate the indicators are set out in **Annex A**.

[8] JNCC on behalf of the UK Biodiversity Partnership (2010) *The UK Biodiversity Action Plan: Highlights from the 2008 reporting round.* Available online at: http://jncc.defra.gov.uk/page-5398

[9] Defra (2017) *Wild Bird Populations in the UK, 1970-2015.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/614737/UK_Wild_birds_1970_2015_2.pdf

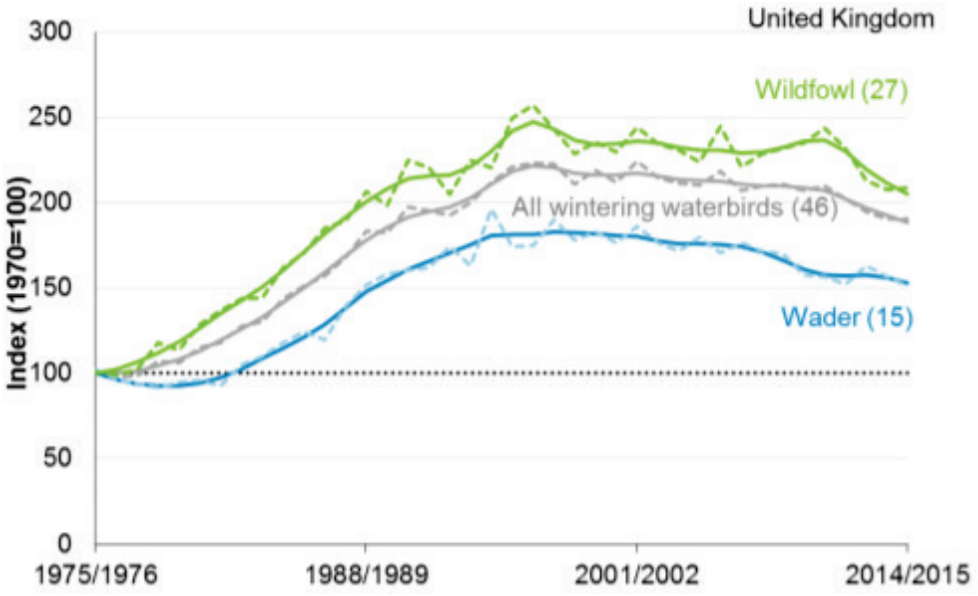
Figure 1.5 Populations of wild birds in the UK, by habitat, 1970-2015[9]



Source: RSPB, BTO, JNCC, Defra.

Note: Figures in brackets show the number of species. Graph shows unsmoothed trends (dashed lines) and smoothed trends (solid lines). No smoothed trend is available for seabirds as individual species population trends are based on full counts at colonies or wetland and coastal sites.

Figure 1.6 Populations of wintering waterbirds in the UK, 1975-76 to 2014-15[9]



Source: RSPB, BTO, JNCC, Defra.

Note: Figures in brackets show the number of species. Graph shows unsmoothed trend (dashed line) and smoothed trend (solid line). Data from surveys of wintering waterbirds are based on full counts at colonies or wetland and coastal sites of markedly varying size. This means that bootstrapping methods cannot be applied and that trends for these groups are currently presented without confidence intervals.

In 2015, the all-species index in the UK was 2% below its 1970 level, although trends vary substantially between different species and habitats. The smoothed index remained level between 2009 and 2014.

Since 1970, populations of breeding farmland birds have declined by over half, with much of this decline taking place between the late seventies and early eighties. Some of the main causes of this decline relate to land management changes and the intensification of farming, a move from spring to autumn sowing of arable crops, change in grassland management, increased pesticide and fertiliser use, and the removal of non-cropped features such as hedgerows. There is also evidence of adverse impacts from disease.

The breeding woodland bird populations have declined by 18% since 1970, with the greatest decline occurring across a 10 year period from the early eighties. The key causes of this are a lack of woodland management and increased deer browsing, which reduces the availability of nesting and foraging habitats. Long-distance migrant woodland birds may also suffer from deterioration of habitats outside the UK.

The breeding water and wetland birds experienced an overall decline of 7% from 1975 to 2015, although between the 26 species there is significant variation. Certain groups within this, such as breeding waders, have experienced historical declines due to changes in land management, intensification of grassland management and the conversion of coastal and floodplain grazing marshes to arable land. Fragmented populations are also vulnerable to predation.

Populations of breeding seabirds have also declined by 22% from 1986 to 2015, with the number of seabirds declining by 6% between 2009 and 2014 alone. In 2013 numbers dipped to the lowest ever but have since increased slightly.

Wintering waterbirds are one of the few populations to show a substantial increase, with populations almost double 1975-76 levels (increase of 92%). This peaked in the late 1990s, and has since had a minor decline. These species are affected by conditions in the countries

where they breed, the condition and amount of coastal and wetland habitat in the UK and changes in migratory patterns.

Bat Populations

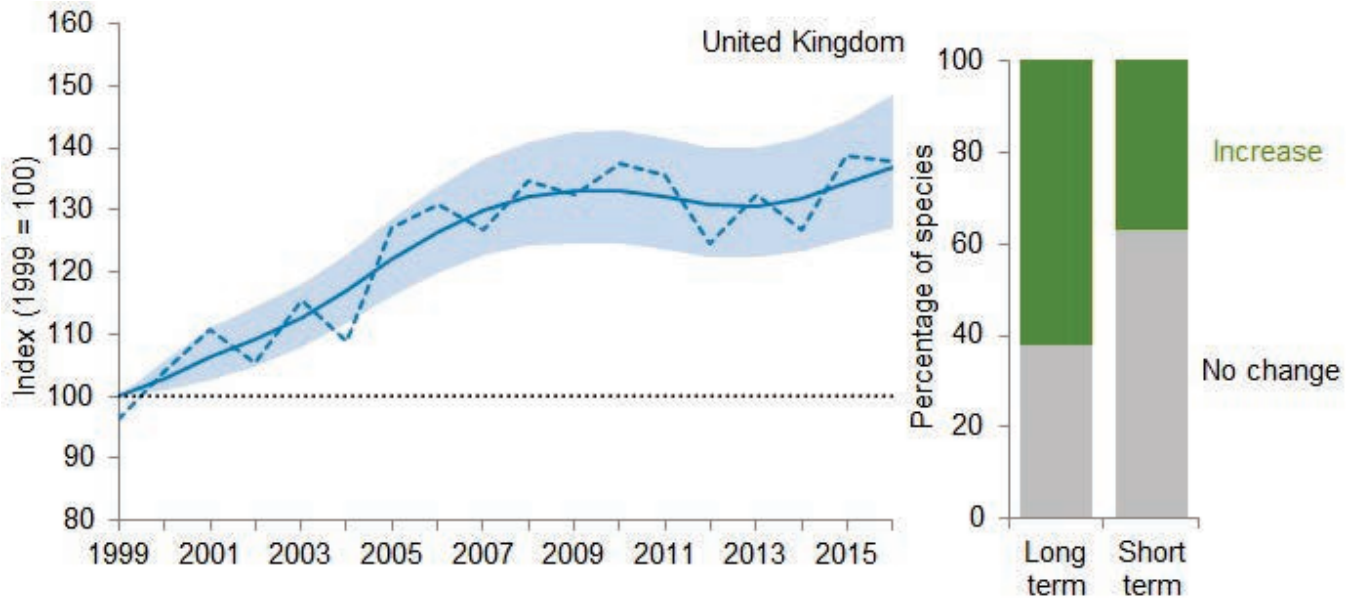
Bat species make up a third of the UK's mammal fauna and occur in most lowland habitats across the UK. Bats are widespread throughout a variety of landscapes including urban areas, farmland, woodland, and river/lake systems. To thrive they require adequate roosting opportunities (particularly for breeding and hibernating), foraging habitat and connected landscape features, such as hedgerows and tree lines that assist them in commuting between roost sites and feeding locations. Key pressures on bats (landscape change, agricultural intensification, development, habitat fragmentation) are also relevant to many other wildlife groups. Bats are sensitive to pollution and factors affecting their insect prey (e.g. pesticides, drainage and land management change). Climatic shifts are predicted to affect bat populations through changes in their yearly hibernation cycles, breeding success and food availability.

Bats have undergone severe declines historically. However, between 1999 and 2015, bat populations have increased significantly by 34% (see **Figure 1.7**)[10]. An assessment by the Bat Conservation Trust of the underlying smoothed trend shows this to be a statistically significant increase. In the short term, between 2010 and 2015, bat populations have shown no significant change in population size.

Of the eight species assessed, five have increased in the long term, and no species have decreased. In the short term, between 2010 and 2015, three species showed an increase in population size, while the others remained stable.

[10] Joint Nature Conservation Committee (2017) *Mammals of the wide countryside (bats)*. Available online at: http://jncc.defra.gov.uk/page-4271

Figure 1.7 Trends in Bat Populations, 1999-2016



Source: Bat Conservation Trust.
Notes:
- The headline measure is a composite index of eight species: brown long-eared bat, common pipistrelle, Daubenton's bat, lesser horseshoe bat, Natterer's bat, noctule, serotine and soprano pipistrelle.
- The model used to produce the indicator has changed since the previous publication, and these results are therefore not directly comparable to previous versions.
- Graph shows unsmoothed trend (dashed line) and smoothed trend (solid line) with its 95% confidence interval (shaded).
- The bar chart shows the percentage of species which, over the time period of the short-term or long-term assessments, have shown a statistically significant increase or decline, or no significant change.

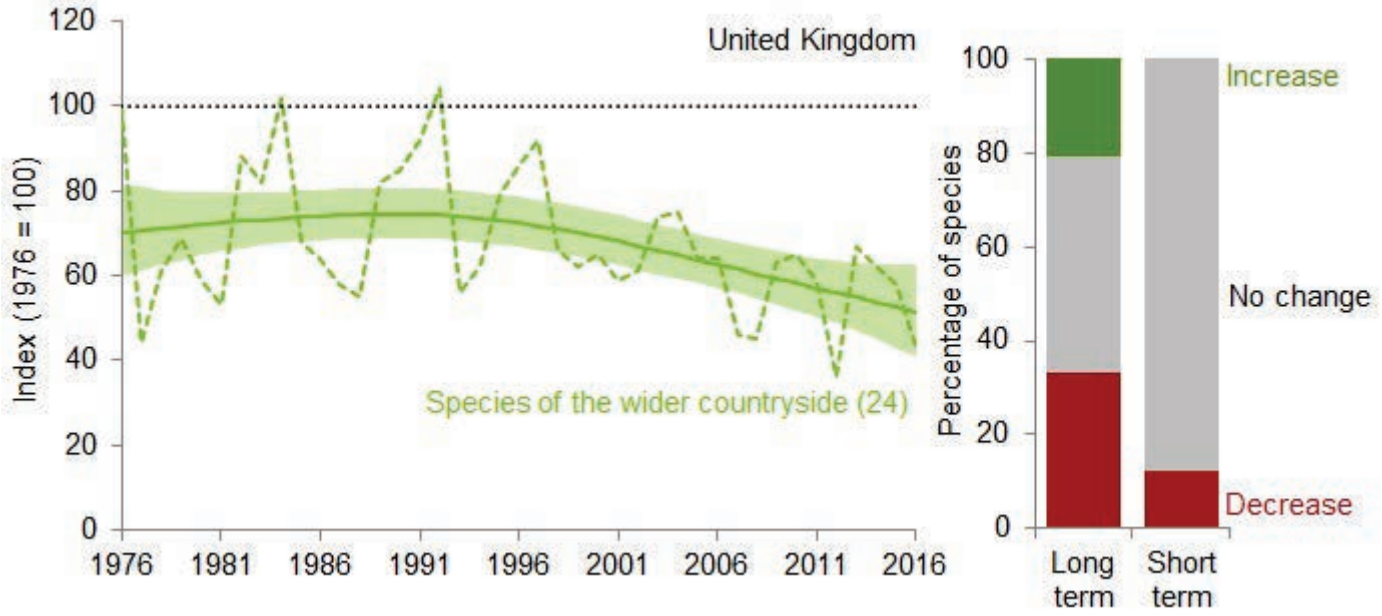
Butterfly Populations

Butterflies respond rapidly to changes in environmental conditions and habitat management, occur in a wide range of habitats, and are representative of many other insects. Butterflies are complementary to birds and bats as an indicator because they use resources in the landscape at a much finer spatial scale than either of these groups.

Trends are monitored in annual populations of specialist butterfly populations (those strongly associated with particular habitats, such as unimproved grassland) and generalist butterflies of the wider countryside. The data shows a high degree of annual variation[11,12]. The assessment of change is therefore made on an analysis of the underlying trends undertaken by Butterfly Conservation and the Centre for Ecology & Hydrology. **Figure 1.8** presents monitored trends since 1976.

[11] Joint Nature Conservation Committee (2017) *Insects of the wider countryside (butterflies).* Available online at: http://www.jncc.gov.uk/page-4236
[12] Dennis, E.B., Freeman, S.N., Brereton, T. & Roy, D.B. 2013. *Indexing butterfly abundance whilst accounting for missing counts and variability in seasonal pattern. Methods in Ecology and Evolution*, 4(7), 637–645

Figure 1.8 Trends in Butterfly Populations in the UK: species of the wider countryside, 1976-2016



Source: British Trust for Ornithology, Butterfly Conservation, Centre for Ecology & Hydrology, Defra, JNCC.

Note:
- Figure in brackets shows the number of species included in the index.
- Line graph shows unsmoothed trend (dashed line) and smoothed trend (solid line) with its 95 per cent confidence interval (shaded).
- Bar chart shows the percentage of species within the indicator that have shown a statistically significant increase, statistically significant decrease or no change.
- Since 2013 an improved analysis method was applied to the measure for species of the wider countryside.
- The chart is not directly comparable to previously published versions, as improvements in the modelling technique have allowed the inclusion of more data, resulting in slight alterations in the trends for individual species.

Large fluctuations in numbers between years are typical features of butterfly populations, and is often linked to weather conditions, with 2016 being notably bad for butterflies. Since 1976, the indices for butterflies associated strongly with semi-natural habitats (specialists) and for those found in the wider countryside show declines of 74% and 57% respectively. Between 2011 and 2016, both specialist species and wider countryside species showed a decline, but this has not been assessed as statistically significant across the short term. In the most recent year (2016), both groups of species also experienced a decrease in population.

England

As of September 2017, there are approximately 4,700 sites designated for nature conservation in England, covering approximately 3.9 million hectares[13]. The designations and corresponding areas are shown below in **Table 1.1**.

Table 1.1 Nature conservation designations and area

Designation	No. of Sites	Total Area (ha)
Ramsar	72	396,602

[13] Natural England (2017) *Designated Sites View database*. Available online at: https://designatedsites.naturalengland.org.uk/SearchEngland.aspx

Designation	No. of Sites	Total Area (ha)
SAC	245	1,017,326
SPA	85	1,304,436
NNR	225	93,616
SSI	4,126	1,093,599

The condition status of the various designations is set out in **Table 1.2**[14,15,16,17,18].

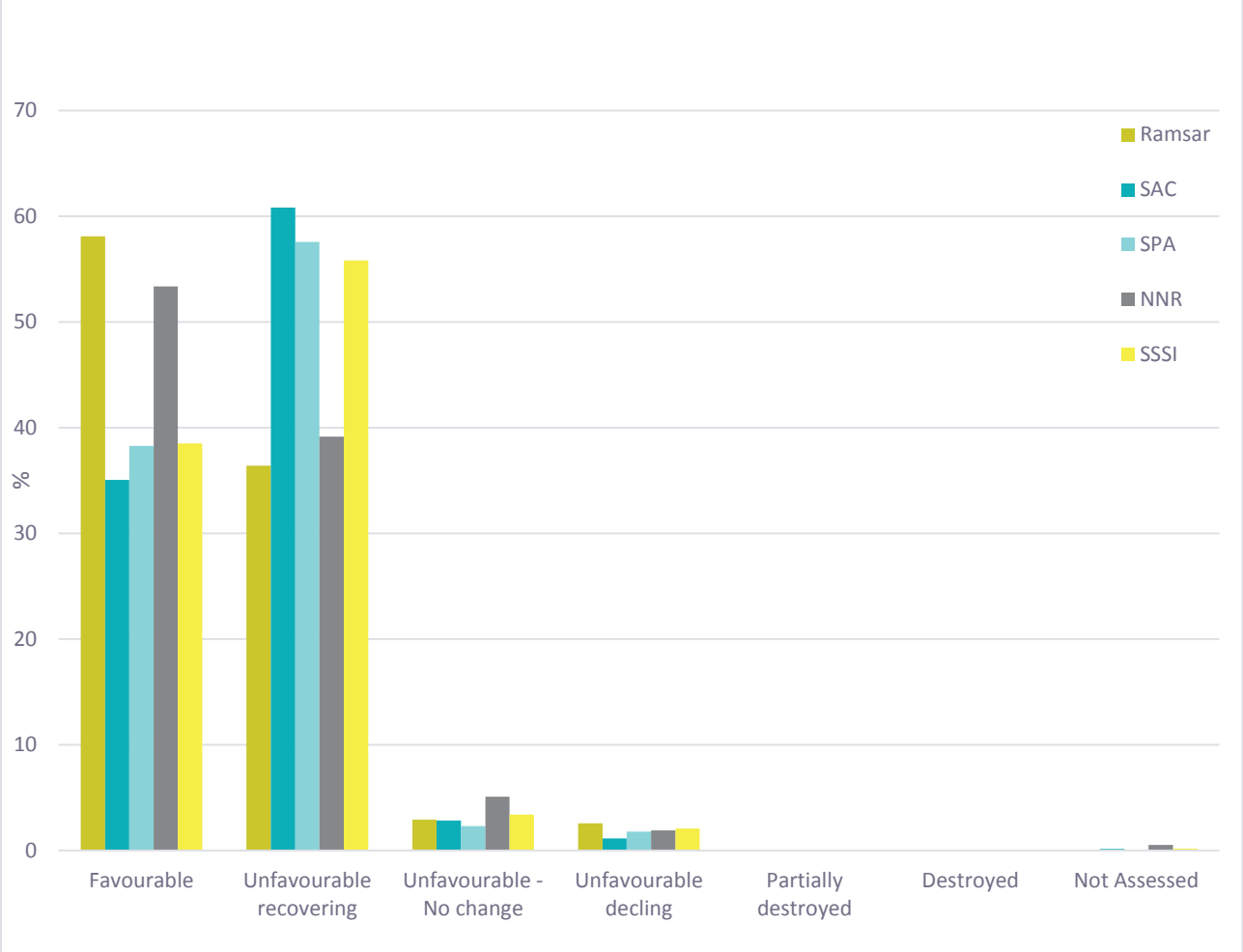
Table 1.2 Condition status of Sites Designated for Nature Conservation

	Favourable	Unfavourable recovering	Unfavourable - No change	Unfavourable declining	Partially destroyed	Destroyed	Not Assessed
Ramsar	58.13%	36.34%	2.94%	2.57%	0.01%	0.00%	0.00%
SAC	35.07%	60.78%	2.82%	1.16%	0.03%	0.00%	0.14%
SPA	38.50%	57.36%	2.30%	1.77%	0.04%	0.00%	0.03%
NNR	53.35%	39.15%	5.02%	1.95%	0.00%	0.00%	0.53%
SSSI	38.52%	55.79%	3.39%	2.08%	0.03%	0.02%	0.18%

The condition status data in **Table 1.2** is shown graphically **Figure 1.9**.

[14] Natural England (2017) *Designated Sites View database*. Available online at: https://designatedsites.naturalengland.org.uk/ReportConditionSummary.aspx?SiteType=ALL
[15] Natural England (2017) *Designated Sites View database*. Available online at:https://designatedsites.naturalengland.org.uk/ReportConditionSummary.aspx?SiteType=NNR
[16] Natural England (2017) *Designated Sites View database*. Available online at:https://designatedsites.naturalengland.org.uk/ReportConditionSummary.aspx?SiteType=SAC
[17] Natural England (2017) *Designated Sites View database*. Available online at:https://designatedsites.naturalengland.org.uk/ReportConditionSummary.aspx?SiteType=SPA
[18] Natural England (2017) *Designated Sites View database*. Available online at:https://designatedsites.naturalengland.org.uk/ReportConditionSummary.aspx?SiteType=RAMSAR

Figure 1.9 Condition status of Sites Designated for Nature Conservation



The reasons for adverse conditions at SSSI sites are set out in **Table 1.3**. This indicates that planning permission (general) was linked to 0.31% of the area not meeting the Public Service Agreement (PSA) Target for SSSIs[19].

Table 1.3 Reasons for Adverse Condition Summary

Adverse Condition Reason	Num Units	Area of Units (ha)	% of unit area not meeting the PSA target
Other (the adverse condition reason doesn't fall into one of the categories below)	381	10,319.50	12.98%
Agriculture - Overgrazing	207	9,368.67	11.79%
Freshwater Pollution - Water Pollution - Agriculture/Run Off	275	5,942.15	7.48%

[19] All Public Service Agreement targets were abolished in 2010. The PSA target was for 95% of SSSIs to be in either 'favourable' or 'unfavourable recovering' condition by 2010.

Adverse Condition Reason	Num Units	Area of Units (ha)	% of unit area not meeting the PSA target
Agriculture - Undergrazing	419	5,016.00	6.31%
Freshwater - Inappropriate Water Levels	181	4,724.28	5.94%
Lack of Corrective Works - Inappropriate Scrub Control	470	4,519.74	5.69%
Freshwater - Drainage	156	4,217.69	5.31%
Freshwater Pollution - Water Pollution - Discharge	188	3,817.32	4.80%
Freshwater - Invasive Freshwater Species	118	3,357.79	4.22%
Forestry - Forestry and Woodland Management	223	2,872.96	3.61%
Fire - Moor Burning	11	2,568.68	3.23%
Agriculture - Agriculture - Other	99	1,873.37	2.36%
Agriculture - Inappropriate Stock-Feeding	9	1,819.67	2.29%
Public Access/Disturbance - Public Access/Disturbance	98	1,802.41	2.27%
Freshwater - Siltation	90	1,572.94	1.98%
Coastal - Coastal Squeeze	31	1,480.56	1.86%
Lack of Corrective Works - Inappropriate Weed Control	129	1,428.78	1.80%
Lack of Corrective Works - Inappropriate Ditch Management	106	1,316.32	1.66%
Freshwater - Inappropriate Weirs Dams and Other Structures	61	1,296.01	1.63%
Forestry - Deer Grazing/Browsing	76	1,177.67	1.48%
Freshwater - Fish Stocking	56	1,175.88	1.48%
Agriculture - Inappropriate Cutting/Mowing	103	1,174.71	1.48%
Agriculture - Inappropriate Css/Esa Prescription	28	989.27	1.24%
Agriculture - Fertiliser Use	28	752.14	0.95%
Freshwater - Water Abstraction	44	711.69	0.90%
Vehicles - Vehicles - Other	16	625.79	0.79%
Coastal - Inappropriate Coastal Management	32	624.08	0.79%
Fire - Fire - Other	36	517.10	0.65%
Vehicles - Vehicles - Illicit	24	405.93	0.51%

Adverse Condition Reason	Num Units	Area of Units (ha)	% of unit area not meeting the PSA target
Earth Science - Earth Science Feature Obstructed	125	395.03	0.50%
Air Pollution - Air Pollution	13	371.84	0.47%
Game Management - Game Management - Other	8	292.26	0.37%
Planning Permission - Planning Permission - General	50	248.43	0.31%
Lack of Corrective Works - Inappropriate Pest Control	9	203.76	0.26%
Planning Permission - Peat Extraction	9	174.42	0.22%
Game Management - Game Management - Pheasant Rearing	12	111.04	0.14%
Planning Permission - Planning Permission - Other Mineral And Waste	14	91.13	0.11%
Coastal - Inappropriate Dredging	5	54.04	0.07%
Freshwater - Inland Flood Defence Works	9	35.29	0.04%
Earth Science - Earth Science Feature Removed	10	31.53	0.04%
Agriculture - Pesticide/Herbicide Use	1	5.02	0.01%

Source: Natural England: Designated Sites.
https://designatedsites.naturalengland.org.uk/ReportUnitAdverseCondition.aspx?ReportTitle=All%20of%20England%20adverse%20conditions

Natural Areas

Natural England has defined 120 (97 terrestrial, 23 marine) geographical areas of the English countryside, distinguished on the merit of their wildlife and other natural features, and also on historic land-use pattern. The boundaries of these zones should be considered as broad transition zones rather than hard, defined edges. The purpose of these areas is to characterise areas of England for their natural features outside, but inclusive of, the network of protected, designated sites (e.g. SPAs, SACs, SSSIs). Each Natural Area is characterised by geology and wildlife allowing a landscape scale approach to biodiversity. Natural Areas have been formally defined as “biogeographic zones which reflect the geological foundation, the natural systems and processes and the wildlife in different parts of England, and provide a framework for setting objectives for nature conservation” (UK Biodiversity Steering Group 1995). **Figure 1.10** identifies Natural Areas of England.

Figure 1.10 Natural Areas of England

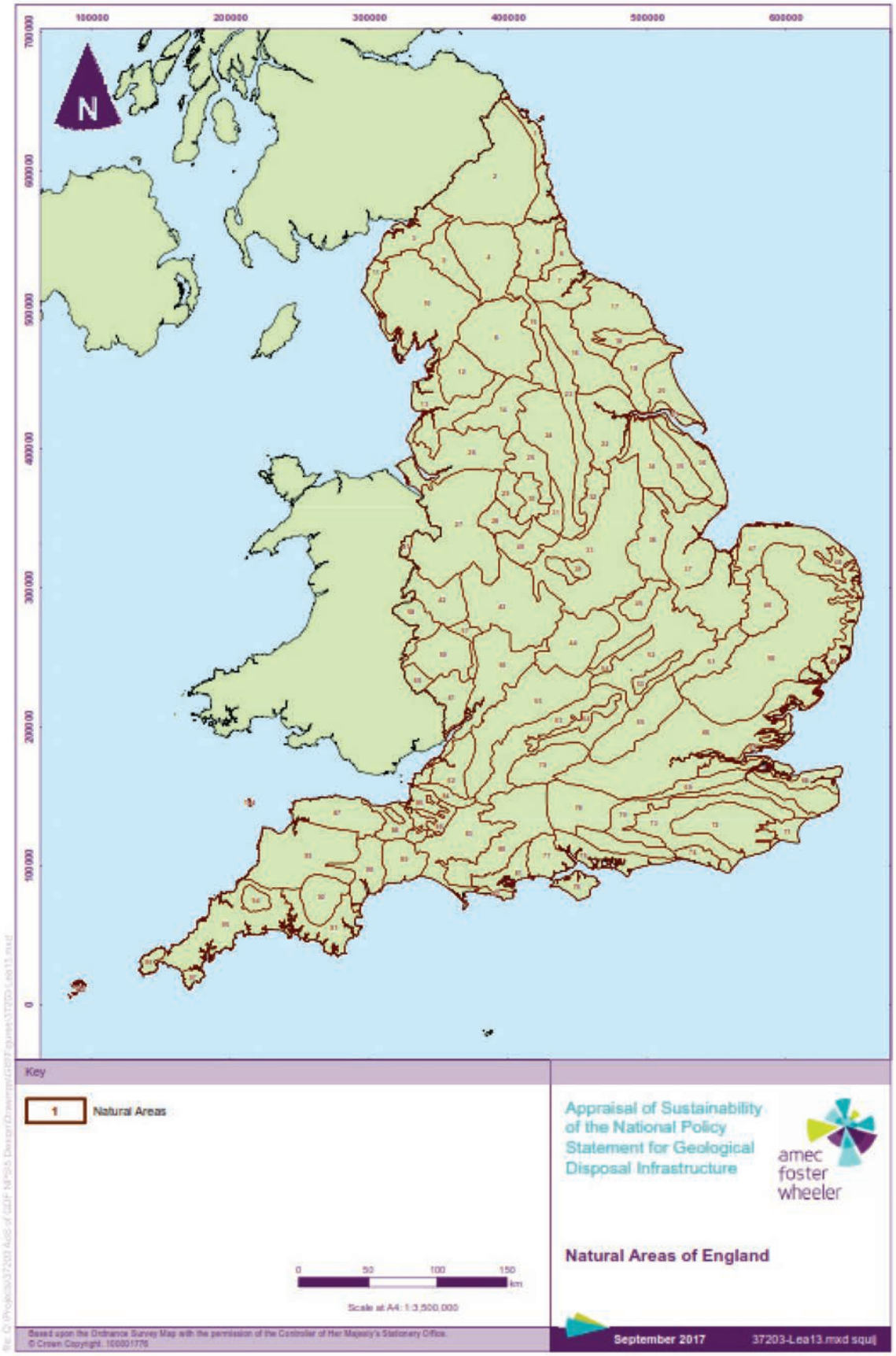


Table 1.4 lists the Natural Areas identified in Figure 1.10.

Table 1.4 Natural Areas

Name	Reference	Name	Reference
North Northumberland Coastal Plain	1	East Anglian Chalk	51
Border Uplands	2	West Anglian Plain	52
Solway Basin	3	Bedfordshire Greensand Ridge	53
North Pennines	4	Yardley-Whittlewood Ridge	54
Northumbria Coal Measures	5	Cotswolds	55
Durham Magnesian Limestone Plateau	6	Severn And Avon Vales	56
Tees Lowlands	7	Malvern Hills And Teme Valley	57
Yorkshire Dales	8	Clun And North West Herefordshire Hills	58
Eden Valley	9	Central Hertfordshire	59
Cumbria Fells and Dales	10	Black Mountains and Golden Valley	60
West Cumbria Coastal Plain	11	Dean Plateau and Wye Valley	61
Forest of Bowland	12	Bristol, Avon Valleys and Ridges	62
Lancashire Plain and Valleys	13	Thames And Avon Vales	63
Southern Pennines	14	Midvale Ridge	64
Pennine Dales Fringe	15	Chilterns	65
Vale of York And Mowbray	16	London Basin	66
North York Moors and Hills	17	Greater Thames Estuary	67
Vale of Pickering	18	North Kent Plain	68
Yorkshire Wolds	19	North Downs	69
Holderness	20	Wealden Greensand	70
Humber Estuary	21	Romney Marshes	71
Humberhead Levels	22	High Weald	72
Southern Magnesian Limestone	23	Low Weald And Pevensey	73
Coal Measures	24	South Downs	74
Dark Peak	25	South Coast Plain and Hampshire Lowlands	75
Urban Mersey Basin	26	Isle of Wight	76
Mosses and Meres	27	New Forest	77
Potteries and Churnet Valley	28	Hampshire Downs	78
South West Peak	29	Berkshire And Marlborough Downs	79
White Peak	30	South Wessex Downs	80
Derbyshire Peak Fringe and Lower Derwent	31	Dorset Heaths	81
Sherwood	32	Isles Of Portland And Purbeck	82
Trent Valley and Rises	33	Wessex Vales	83
North Lincolnshire Coversands And Clay Vales	34	Mendip Hills	84
Lincolnshire Wolds	35	Somerset Levels and Moors	85
Lincolnshire Coast and Marshes	36	Mid Somerset Hills	86
The Fens	37	Exmoor And the Quantocks	87
Lincolnshire And Rutland Limestone	38	Vale of Taunton And Quantock Fringes	88

Name	Reference	Name	Reference
Charnwood	39	Blackdowns	89
Needwood And South Derbyshire Claylands	40	Devon Redlands	90
Oswestry Uplands	41	South Devon	91
Shropshire Hills	42	Dartmoor	92
Midlands Plateau	43	The Culm	93
Midland Clay Pastures	44	Bodmin Moor	94
Rockingham Forest	45	Cornish Killas And Granites	95
Breckland	46	West Penwith	96
North Norfolk	47	The Lizard	97
The Broads	48	Isles of Scilly	113
Suffolk Coast and Heaths	49	Lundy	114
East Anglian Plain	50		

National Character Areas

England has been divided into areas with similar landscape character, which are called National Character Areas (NCAs). A total of 159 NCAs have been identified in England[20]. The boundaries of the NCAs are not precise and many should be considered as broad zones of transition. Natural England have rewritten and redesigned all of England's 159 NCA profiles and published the revised profiles in September 2014. The NCAs are defined by a unique combination of landscape, biodiversity, geodiversity, history, and cultural and economic activity (further discussion of National Character Areas is provided in **Section 14 – Landscape and Townscape**).

Scotland

In Scotland there are:

- 152 SPAs, covering an area of 1,205,448 hectares (in addition to one site which straddles the border with England and is included under the England section above)[21];
- 236 SACs covering an area of 2,289,782 hectares (in addition to three sites that straddle the border with England, which are included under the England section above)[22];
- 50 Ramsar sites covering a total area of 283,083 hectares (in addition to one site which straddles the border with England and is included under the England section above)[23]; and

[20] Natural England (2014) *National Character Area profiles: data for local decision making*. Available online at: https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making
[21] Joint Nature Conservation Committee (2017) *Classified Special Protection Areas in the UK*. Available online at: http://jncc.defra.gov.uk/page-1399
[22] Joint Nature Conservation Committee (2017) *Special Areas of Conservation (SAC).* Available online at: http://jncc.defra.gov.uk/page-23
[23] Joint Nature Conservation Committee (2017) *UK Ramsar sites*. Available online at: http://jncc.defra.gov.uk/page-1388

- as of February 2014, 1,425 SSSIs covering 1,020,000 hectares or 13% of Scotland[24].

In 2005, 71.4% of designated sites in Scotland (including SPAs, SACs, Ramsar and SSSI) were in favourable or unfavourable recovering condition. By March 2017, 80.3% of natural features on protected nature sites were assessed as being in favourable or unfavourable recovering condition; 0.1 percentage points lower than in March 2016 and 8.9 percentage points higher than in 2005[25]. During 2016-17, the condition of 91 features improved to favourable or recovering condition. During the same period, the condition of 79 features deteriorated to unfavourable condition. The greatest stresses on sites were identified as invasive species and over-grazing.

Scottish Natural Heritage identified a series of Natural Heritage Zones as part of their Natural Heritage Futures initiative, and used these areas to describe a vision for sustainable use of local natural heritage. A total of 21 zones were identified[26], each having their own identity resulting from the interaction of geology, landforms, wildlife and land use.

Wales

More than 10% of Wales' land cover is designated for nature conservation. Natural Resources Wales State of Natural Resources Report (SoNaRR)[27] identifies the following key messages with regards to protected habitats and species:

- Wales has a wide representation of species across a broad range of taxonomic groups with estimates varying from 25,000 to 50,000 different species of animals, plants and other organisms;
- there are 20 Special Protection Areas (SPAs)[28] for internationally important populations of birds and 92 Special Areas of Conservation (SACs) for other threatened species and natural habitats;
- 562 of the total 1,016 Sites of Special Scientific Interest (SSSI) (as of 2010) have individually qualifying species and 54 have species assemblages which qualify. Many of the same species are also found on sites that qualify for their habitat; and
- the list of species and habitats of principal importance in Wales (the interim Section 7 list) includes 557 species.

Other internationally important sites to consider include the Rhinog Biogenetic Reserve in North Wales (Blaenau Ffestiniog WRZ) and the UNESCO biosphere reserve at Cors Fochno in the Dyfi estuary near Borth in Ceredigion (West Wales)[29]. There are 76 National Nature

[24] Scottish Natural Heritage (2016) *Where are SSSIs found?* Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/sssis/sssi-location/
[25] Scottish Natural Heritage (2017) *The Proportion of Scotland's Protected Sites in Favourable Condition 2017 (Official Statistics 2017)*. Available online at: http://www.snh.gov.uk/publications-data-and-research/official-statistics/official-stats/sites-favourable/
[26] Scottish Natural Heritage (2002) *Natural Heritage Zones: A National Assessment of Scottish Landscapes*. Available online at: http://www.snh.org.uk/futures/Data/pdfdocs/LANDSCAPES.pdf
[27] Natural Resources Wales (2016) *State of the Natural Resources Report*. Available online at: https://naturalresources.wales/evidence-and-data/research-and-reports/the-state-of-natural-resources-report-assessment-of-the-sustainable-management-of-natural-resources/?lang=en
[28] The latest data (June 2017) from the Joint Nature Conservancy Council identifies 21 SPAs; 18 in Wales and 3 cross border SPAs between England and Wales.
[29] The UNESCO Biosphere Reserve status is awarded in recognition of the way a local community lives sustainably in an area of special landscape quality with a rich wildlife. The designated area includes Aberystwyth, Llanbrynmair, Llanymawddwy, Corris Uchaf, and Aberdyfi.

Reserves (NNRs) in Wales, all of which are legally protected as SSSIs. Most are also designated as SACs, SPAs or Ramsar sites[30].

With respect to the condition of these sites, the SoNaRR report identifies that:

- the condition of SAC and SPA species features on sites in Wales, as reported in 2013, remains mostly unfavourable (55%), with the exception of birds and mammals of which 86% and 68% were in favourable condition, respectively;
- between 2002 and 2008, fewer than half of the species on the interim Section 7 list were considered to be stable or increasing; and
- Wales (along with the UK as a whole) did not meet the 2010 international and national biodiversity targets.

Summary of Existing Problems for Biodiversity and Nature Conservation Relevant to the Geological Disposal NPS

The SEA Directive requires consideration of any existing environmental problems which are relevant to the plan or programme, particularly those areas of environmental importance pursuant to Directives 2009/147/EC and 92/43/EC (the Birds and Habitats Directives). An analysis of the causes of unfavourable condition and threats to the range of habitats by Natural England has revealed the key pressures and risks to be:

- habitat destruction and fragmentation by development;
- agricultural intensification and changes in agricultural management practices;
- water abstraction, drainage or inappropriate river management;
- inappropriate coastal management;
- lack of appropriate habitat management;
- atmospheric pollution (acid precipitation, nitrogen deposition);
- water pollution from both point and wider (diffuse) agricultural sources;
- climate change and sea level rise;
- sea fisheries practices;
- recreational pressure and human disturbance; and
- invasive and non-native species[31].

The same threats occur across the devolved administrations in the UK. For example, the Scottish Biodiversity Strategy Report to the Scottish Parliament 2014-16[4] identified seven key issues for biodiversity in Scotland: pollution, land use intensification/modification, invasive species/diseases, lack of recognition of the value of nature, disconnection with nature, climate change and the use of marine resources.

[30] Natural Resources Wales (2016) *National Nature Reserves*. Available online at: https://naturalresources.wales/guidance-and-advice/environmental-topics/wildlife-and-biodiversity/find-protected-areas-of-land-and-seas/national-nature-reserves/?lang=en

[31] Natural England (2008) *State of the Natural Environment Report*

Table 1.5 presents an overview of the key issues for biodiversity and nature conservation relevant to the Geological Disposal NPS.

Table 1.5 Biodiversity and Nature Conservation Problems Relevant to the Geological Disposal NPS

Problem	Supporting Data	Implications
Loss of biodiversity	The status of UK priority habitats and species in 2012 indicates that the decline of biodiversity is a long-term issue. Between 2007 and 2012, populations of priority species declined by 4 per cent relative to their value in 2007. This decrease is not statistically significant. Within the index over this short-term period, 47 per cent of species showed an increase and 53 per cent showed a decline. By 2012, populations of priority species overall had declined to 33 per cent of the 1970 index value, a statistically significant decrease. Over this long-term period 25 per cent of species showed an increase and 75 per cent showed a decline.	Ensure policies do not adversely affect biodiversity.
Risks to the condition of certain habitat features	For NNRs, SSSIs, SPAs, SACs and RAMSAR sites, typically around 95% of the total site area is either in a favourable or recovering state. Whilst this is a positive testament to the efforts to improve these sites, it should be noted that those sites that are 'recovering' remain in an unfavourable state at present and gains in their status could be reversed. It should be noted that those sites of nature conservation importance that were least favourable were often impacted by factors which operated outside the sites on which they were designated (e.g. drainage conditions for some isolated wetlands) and which require concerted effort by many agencies (e.g. water quality affecting fish).	Ensure policies do not adversely affect the status of conservation features.

Likely Evolution of the Baseline

UK

The general global trend in biodiversity is towards a decreased level of variability among living organisms. The European Commission states that "*The loss of biodiversity has accelerated to an unprecedented level in Europe and worldwide. It has been estimated that the current global extinction rate is 1,000 to 10,000 times higher than the natural background extinction rate. In*

Europe some 42% of European mammals are endangered, together with 15% of birds and 45% of butterflies and reptiles"[32].

The global trend towards a decline in biodiversity is not mirrored in the UK. The annual review of UK Biodiversity Indicators comprises 49 measures, of which 7 are not assessed in the long term and 10 are not assessed in the short term. Of the 46 long-term measures, 20 show an improvement, compared to 11 of the measures which were deteriorating. Of the 39 short–term measures, 11 show an improvement, compared to 12 in decline. Measures that improved or deteriorated in the long term have not necessarily continued to improve or deteriorate respectively in the short term[33].

Measures which have improved in the long term include: volunteer time spent in conservation; area of land in agri-environment schemes; area of forestry land certified as sustainably managed; sustainable fisheries; pressure from pollution; protected areas; wintering waterbirds; mammals of the wider countryside (bats); animal genetic resources; plant genetic resources; greenhouse gas removals by UK forests; cumulative number of records; and expenditure on UK and international biodiversity.

Measures showing an improvement in the short term include: sustainable fisheries; marine pollution (heavy metals); total area of protected sites: at sea; status of UK species of European importance; animal genetic resources; plant genetic resources; fish size classes in the North Sea; greenhouse gas removals by forests; biodiversity data for decision making.

Measures showing long-term deterioration include: pressure from invasive species; status of UK priority species: relative abundance; birds of the wider countryside and at sea; insects in the wider countryside (butterflies); animal genetic resources – horse breeds; and status of pollinating insects.

Some of these measures have continued to deteriorate in the short term, including birds of the wider countryside and at sea, the status of UK priority species and animal genetic resources, in addition to declines in: volunteer time spent in conservation; area of land in agri-environment schemes; surface water status; status of UK habitats of European importance; and expenditure on UK and international biodiversity.

A 2016 report by the UK's non-statutory wildlife organisations[34] sets out the following headline results of their assessment of the state of the UK's biodiversity resource:

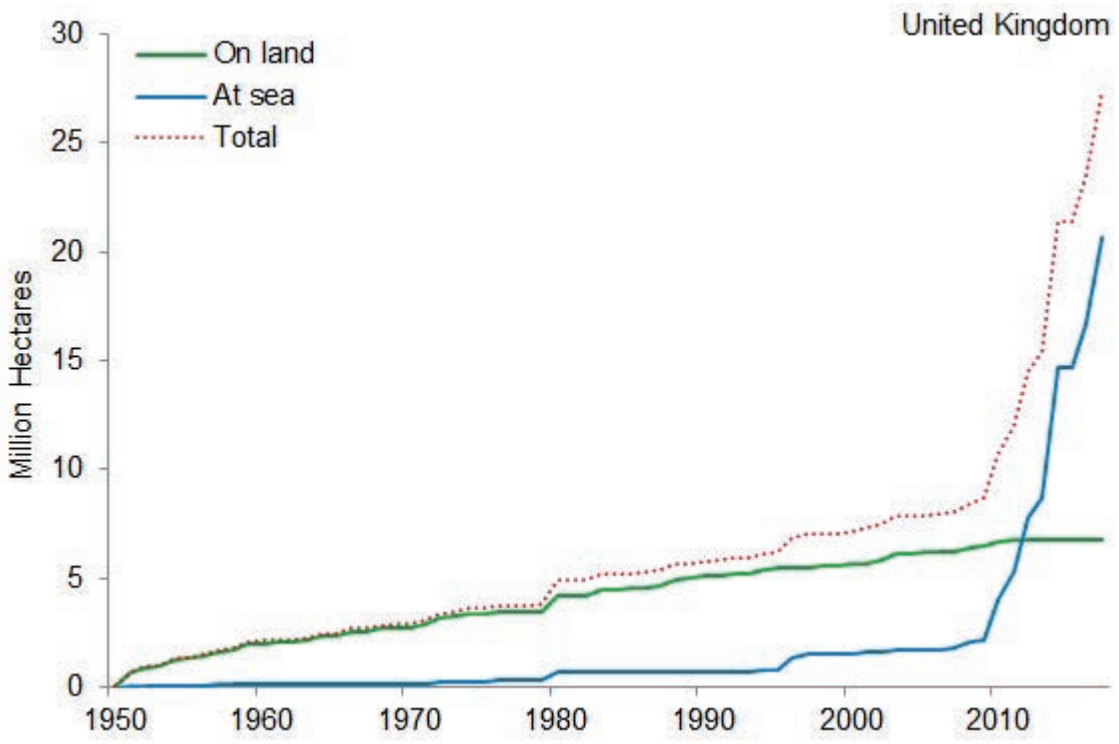
- Using records of 3,816 species, some 56% of these have declined since 1970 and 44% have increased;
- Of the nearly 8,000 species assessed using modern Red List criteria, 15% are extinct or threatened with extinction from Great Britain;
- An index of species' status, based on abundance and occupancy data, has fallen by 16% since 1970, and 3% from 2002. An index describing the population trends of species of special conservation concern in the UK has fallen by 67% since 1970 and 12% from 2002;

[32] European Commission (2016) *Why do we need to protect biodiversity*. Available online at: http://ec.europa.eu/environment/nature/biodiversity/intro/index_en.htm
[33] Defra (2017) *UK Biodiversity Indicators 2017*. Available online at: http://jncc.defra.gov.uk/pdf/UKBI_2017.pdf
[34] Hayhow DB, Burns F, Eaton MA, *et al*. (2016) *State of Nature 2016*. The State of Nature partnership. Available online at: http://www.rspb.org.uk/Images/State%20of%20Nature%20UK%20report_%2020%20Sept_tcm9-424984.pdf

- Policy-driven agricultural change was the most significant driver of declines, although climate change has also had a significant impact, which included both beneficial and detrimental effects on species. Climate change is highlighted as one of the greatest long-term threats to nature globally; and
- A new measure that assesses how intact a country's biodiversity is suggests that the UK has lost significantly more nature over the long term than the global average.

In response to these challenges and to ensure habitats and species receive protection in the UK, there has been an increase in the number of sites and areas protected for biodiversity, flora and fauna[35] (see **Figure 1.11**).

Figure 1.11 Extent of UK Nationally and Internationally Important Protected Areas: (i) on-land; (ii) at-sea, 1950 to 2017



Source: Joint Nature Conservation Committee, Natural England, Natural Resources Wales, Northern Ireland Environment Agency and Scottish Natural Heritage.

Notes: - The boundary between protected areas on-land and at-sea is mean high water (mean high water spring in Scotland). Coastal sites in the indicator are split between 'on-land' and 'at-sea' if they cross the mean high water mark. At-sea extent includes offshore marine protected areas out to the limit of the UK continental shelf.

- Based on calendar year of site designation. For 2017, the data cut-off is 31 March.

- Extent is based on the following site designations: Areas of Special Scientific Interest, Sites of Special Scientific Interest, National Nature Reserves, Marine Conservation Zones, Nature Conservation Marine Protected Areas, Ramsar Sites, Special Areas of Conservation (including candidate Special Areas of Conservation and Sites of Community Importance), Special Protection Areas, Areas of Outstanding Natural Beauty, National Scenic Areas, National Parks.

The overall total extent of land and sea protected in the UK through national and international protected areas, and through wider landscape designations, has increased by 12.9 million hectares over five years, from 14.5 million hectares in December 2012 to 27.4 million hectares at the end of March 2017. This increase is almost entirely down to the designation of inshore and offshore marine sites.

[35] JNCC (2017) *Protected Areas.* Available online at: http://jncc.defra.gov.uk/page-4241

The indicator also shows the condition of Areas or Sites of Special Scientific Interest (A/SSSIs) on land. A/SSSIs are surveyed periodically to assess whether they are in good condition (favourable) or, if not, they are under positive management (unfavourable-recovering). Since 2005, the percentage of features or area of A/SSSIs in favourable or recovering condition has increased from 67% to 86% in 2012, and remained stable at 86% in 2017. This change reflects improved management of sites, but may also be affected by a greater number of sites/features having been assessed over time. The majority of protected areas on land are A/SSSIs, so the condition indicator is not representative of marine sites.

Aichi Goals and Targets

The Strategic Plan for Biodiversity 2011-2020, agreed at Nagoya in the Aichi Prefecture, Japan at the tenth Conference of the Parties of the CBD established five strategic goals and 20 new global 'Aichi' targets. These were then reflected in the UK Post-2010 Biodiversity Framework (2012). Those relevant to the UK and set out in the UK Post 2010 Biodiversity Framework include, among others:

- **Strategic Goal B**: Reduce the direct pressures on biodiversity and promote sustainable use.
  - **Target 5:** By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.
  - **Target 7**: By 2020, areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.
- **Strategic Goal C**. To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity.
  - **Target 11**: By 2020, at least 17% of terrestrial and inland water, and 10% of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes.
  - **Target 12**: By 2020, the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.
  - **Target 13**: By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.
- **Strategic Goal D**. Enhance the benefits to all from biodiversity and ecosystems.
  - **Target 15**: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15% of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

England

Results of the 2017 reporting of biodiversity indicators for England[36] reveal that, of the 50 individual measures making up the indicators, 17 of the 33 measures assessed over the long term show an improvement, as do 14 of the 35 measures that are assessed over the short term. 10 measures (20%) and 11 measures (22%) show a decline in the long term and short term, respectively.

Those showing a deterioration over the long term are:

- change in the status of priority species – abundance;
- woodland birds;
- butterflies of the wider countryside on woodland;
- breeding farmland birds;
- butterflies of the wider countryside on farmland;
- status of pollinating insects; and
- effective population size of native horse breeds at risk.

There has been a net decrease in the area of SSSIs in favourable condition; down from 44% in 2003 to 39% in 2017. It is evident from this that restoring species and habitats to favourable condition is difficult and to reverse previous declines in species populations or to restore the ecological functioning of habitats will take many years. However, the area of SSSIs in unfavourable recovering condition increased substantially from 13% in 2003 to 56% in 2017, and only 2% of SSSIs had unfavourable declining status. This suggests that the overall status of protected sites would be to continue to improve into the future, with an increasing number achieving favourable status.

The GB Non-native Species Strategy identifies that the number of non-native species entering GB is increasing, with 10-12 new non-native species becoming established every year and that this trend is mirrored across Europe and the rest of the world. If it is not addressed, it is expected to continue increasing for the foreseeable future[37].

The total extent of land and sea protected in England through national and international protected areas increased from 1.2 million to 3.9 million hectares between 1999 and 2017, an increase of 225%.

Identifying an overall trend for biodiversity in England would be to risk masking various significant trends at the species / habitat level. The interaction between trends is also highly uncertain. For example, **Figure 1.11** identifies that an increasingly large area of the UK is being protected for nature conservation. The biodiversity indicators for England identify an ongoing decline in both the abundance and distribution of priority species. It is possible that the increasing area of protected land may halt the decline in biodiversity, but there is a high degree of uncertainty.

[36] Defra (2017) Biodiversity 2020: a strategy for England's wildlife and ecosystem services – Indicators. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/635368/England_biodiversity_indicators_full_2017_rev.pdf
[37] Defra, Scottish Government, Welsh Government (2015) *The Great Britain Invasive Non-native Species Strategy*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/455526/gb-non-native-species-strategy-pb14324.pdf

Two of the biodiversity indicators in decline relate directly to agricultural land, however agricultural practices may be affected by the UK's withdrawal from the European Union. How agricultural practices may change, and in turn the effect on biodiversity, is uncertain.

Scotland

Results of the 2008 reporting round of the UK Biodiversity Action Plan indicate that in Scotland[38]:

Habitats:

- 13% of priority habitats were increasing (compared to 15% in 2005);
- 21% of priority habitats were stable (compared to 20% in 2005);
- 3% of habitats were declining (continuing/accelerating) (compared to 0% in 2005);
- 26% of habitats were declining (slowing) (compared to 29% in 2005);
- 16% of habitats were fluctuating (compared to 2% in 2005);
- 3% of habitats showed no clear trend (compared to 7% in 2005); and
- the status of 21% of habitats was unknown (compared to 27% in 2005).

Species:

- 4% of species were increasing (compared to 5% in 2005);
- 23% of species were stable (compared to 24% in 2005);
- 15% of species were fluctuating (compared to 3% in 2005);
- 11% of species were declining (slowing) (compared to 9% in 2005);
- 7% of species were declining (continuing/accelerating) (compared to 5% in 2005);
- 1% of species were lost (pre BAP publication) (no change since 2005);
- 7% of species showed no clear trend (compared to 8% in 2005); and
- the status of 32% of species was unknown (compared to 42% in 2005).

By March 2016, 80.4% of natural features on protected nature sites (SPAs, SACs, Ramsar and SSSI) were assessed as being in favourable or unfavourable recovering condition.

The latest monitoring information on biodiversity in Scotland was reported in 2010[39]. Based on the European BAP Framework, eight priority objectives, four supporting measures and 37 targets for action were specified for Scotland. By the end of 2010, 59% of these actions were on target (e.g. principal pollutant pressures on terrestrial and freshwater biodiversity substantially reduced by 2010), 24% had room for improvement (e.g. climate change adaptation and mitigation measures) and 16% were not on target (e.g. reducing the impact of invasive non-native species).

[38] Scottish Government (2016) *Key Scottish Environment Statistics 2015*. Available online at: http://www.gov.scot/Publications/2015/09/4066/318461

[39] Mackey, E.C. and Mudge, G. (2010). *Scotland's Wildlife: An assessment of biodiversity in 2010*. Available online at: http://www.snh.gov.uk/docs/B811968.pdf

Wales

The SoNaRR report[27] identified the following trends:

- the extent and population for terrestrial, freshwater and marine species vary enormously within taxonomic groups; with some species increasing and some decreasing. For instance, both increases and decreases can be seen in birds, bats and many pollinator species (e.g. bees, butterflies) whilst for many species we do not have sufficient data on which to base any conclusions;
- there has been a marked reduction in the abundance of salmon in recent years, particularly in the southern regions of the species' range which is linked to increased mortality at sea. Although stocks in many of our industrial rivers have improved in the last 30 years, most stocks in Wales are severely challenged;
- all species are directly affected by changes in habitat quantity and quality. These changes are directly related to changes in the intensity of management regimes. Fragmentation and eutrophication create particular problems for many species; and
- there are risks to species and habitats due to their inability to respond to changing climatic conditions. There may also be opportunities from new species colonisations. Conversely, native wildlife may be increasingly at risk from pests, pathogens and invasive species. There are also risks from change in the frequency and/or magnitude of extreme weather and wildfire events. Climate change is influencing the expansion or contraction of some species' ranges and populations, and the increasing frequency of extreme climatic events, predicted in many climate change scenarios, may have serious implications.

Assessing Significance

The objectives and guide questions related to biodiversity and nature conservation which have been identified for use in assessing the effects of Geological Disposal infrastructure NPS proposals and alternatives are set out in **Table 1.6**, together with reasons for their selection.

Table 1.6 Approach to Assessing the Effects of the Geological Disposal infrastructure NPS on Biodiversity and Nature Conservation

Objective/Guide Question	Reasoning
Objective: To protect and enhance biodiversity (habitats, species and ecosystems) working within environmental capacities and limits.	The SEA Directive (2001/42/EC) requires that the likely significant effects on biodiversity should be taken into account in the Environmental Report, which for the purposes of the AoS is incorporated within the AoS Report.
Will the Geological Disposal Infrastructure NPS protect and/or enhance internationally designated nature conservation sites e.g. Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar Sites?	The Habitats Directive (92/43/EEC) and the Birds Directive (2009/147/EC) include measures to maintain or restore important natural habitats and species including through the designation of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).
Will the Geological Disposal Infrastructure NPS protect and/or enhance nationally designated nature conservation sites e.g. Sites of	The Wildlife and Countryside Act 1981 includes measures relating to protected sites. Devolved administrations have prepared detailed action plans on protecting habitats and species e.g. Biodiversity 2020 – A Strategy for England's Wildlife and Ecosystem Services (Defra 2011),

Objective/Guide Question	Reasoning
Special Scientific Interest (SSSIs)?	Scotland's 2020 Challenge (a supplement to the Scottish Biodiversity Strategy 2004) and Wales Natural Resource Policy (2017).
Will the Geological Disposal Infrastructure NPS affect animals or plants including protected species?	The Wildlife and Countryside Act 1981 includes legislation relating to protected sites. Devolved administrations are preparing detailed action plans on protecting habitats and species.
Will the Geological Disposal Infrastructure NPS protect and/or enhance priority species and habitats?	The National Planning Policy Framework (NPPF) promotes the protection and enhancement of Species and Habitats of Principal Importance included in the England Biodiversity List published by the Secretary of State under section 41 of the Natural Environment and Rural Communities Act 2006 (known as priority species and habitats).
Will the Geological Disposal Infrastructure NPS affect the structure and function of natural systems (ecosystems)?	Biodiversity is a highly sensitive receptor. It is likely that many of the other topics considered in this report will have an effect on biodiversity. Ecosystems will be sensitive to these interconnected effects.
Will the Geological Disposal Infrastructure NPS affect public access to areas of wildlife interest?	The Countryside and Rights of Way Act addresses public rights of way and access to open land.
Will the Geological Disposal Infrastructure NPS have an impact on fisheries?	Various inland waters could be affected by the Geological Disposal NPS meaning that the provisions of the Water Framework Directive (WFD) (2000/60/EC) apply as they relate to the quality of freshwaters needing protection or improvement in order to support fish life.

Table 1.7 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the biodiversity and nature conservation objective.

Table 1.7 Illustrative Guidance for the Assessment of Significance for Biodiversity and Nature Conservation

Effect	Description	Illustrative Guidance
++	Significant Positive	• Option would have a significant and sustained positive effect on European or national designated sites and/or protected species. (e.g. – fully supports all conservation objectives on site, long-term increase in population of designated species); • Option will create new areas of wildlife interest with improved public access in areas where there is a high demand for access to these sites.
+	Positive	• Option would have a minor positive effect on European or national designated sites and/or protected species (e.g. – supports one of the conservation objectives on site, short-term increase in population of designated species); • Option would have a positive effect on local biodiversity (e.g. – through removal of all existing disturbance/pollutant emissions, or creation of new habitats leading to long-term improvement to ecosystem structure and function); • Option would enhance existing public access to areas of wildlife interest in areas where there is some demand for these sites.
0	Neutral	• Option would not have any effects on European or national designated sites and/or any species (including both designated and non-designated

Effect	Description	Illustrative Guidance
		species); • Option would not affect public rights of way or access to areas of wildlife interest.
-	Negative	• Option would have negative effects on local biodiversity (e.g. – through an increase in disturbance/pollutant emissions, or some loss of habitat leading to temporary loss of ecosystem structure and function); • Option would decrease public access to areas of wildlife interest in areas where there is some demand for access to these sites.
--	Significant Negative	• Option would have a negative effect on European or national designated sites and/or protected species (i.e. on the interest features and integrity of the site, by preventing any of the conservation objectives from being achieved or resulting in a long-term decrease in the population of a priority species). These effects could not be reasonably mitigated.
?	Uncertain	• From the level of information available the effect that the option would have on this objective is uncertain.

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 1.8 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria'[40] and 'No NPS' on the biodiversity and nature conservation objective. The appraisal considers in-turn the three sub-sections used for each topic within Chapter 5 (Impacts) of the draft NPS: Applicant's Assessment; Decision Making (subdivided into specific areas of interest) and Mitigation. The performance of the draft NPS and the two reasonable alternatives are scored accordingly, with a commentary provided in the Appraisal column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15 - 20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement. These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-term (less than 20 years), MT – medium-term (between 20 and 170 years) and LT – long-term (>170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

[40] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

Table 1.8 Appraisal of the Draft NPS and Reasonable Alternatives: Biodiversity and Nature Conservation

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	**+**	**++/?**	**+/?**	**Draft NPS:** The text in the draft NPS under the heading of the Applicant's Assessment (paragraph 5.4.3) states that "*the applicant should ensure that the Environmental Statement clearly sets out any likely significant impacts on internationally, nationally and locally designated sites of ecological or geological conservation importance (including those outside England). The Environmental Statement must also consider the full range of potential impacts on ecosystems including habitats, protected species or species identified as being of principal importance to biodiversity and nature conservation.*" The current text does not provide guidance on the contents of an Environmental Statement with regards to biodiversity. The text goes onto draw attention to surface and underground facilities. It concludes with opportunities to conserve and enhance biodiversity and geological conservation interests. The requirement for the preparation of an Environmental Statement (ES) will ensure that the likely effects on biodiversity are properly considered (subject to more detailed specification of the contents of the ES in respect of biodiversity). Consideration of surface and underground facilities will help to ensure that the full range of impacts is taken into account. The requirement for conservation and enhancement should help to promote activities such as off-setting, where appropriate. Overall, there are likely to be positive effects on biodiversity interests. *Recommendations for Improvement* It would be useful for the text to make direct reference to the Planning Practice Guidance on how biodiversity matters should be dealt with as part of a development consent application (PPG Natural Environment Biodiversity and ecosystems, Paragraph: 016 Reference ID: 8-016-20140612; and PPG Natural Environment Green infrastructure, Paragraph: 032 Reference ID: 8-032-2160211). Direct reference to Planning Policy Guidance will also serve to substantiate links to the enhancement of biodiversity interests through means such as Green Infrastructure and biodiversity off-setting to ensure that the Applicant's Assessment makes the most of these opportunities (which are further specified under-Decision Making). Consideration should be given to providing further guidance on the possible contents of the ES with regards to biodiversity and nature conservation. Specification of the contents of the ES could be drawn from the following[41] which in turn serves as the reference point for the detail of the Decision Making section: • Scoping o Identify the likely zone of influence of the proposed development. o Identify and evaluate ecological resources and features (habitats, species and ecosystems, including ecosystem function and processes) likely to be affected (could include ecological survey/research). o Describe any future anticipated changes to ecological conditions in the absence of the proposed project, to inform the assessment of impacts. o Provide the basis for determining significance of effects arising from the impacts.

[41] Chartered Institute of Ecology and Environmental Management (2016) *Guidelines for Ecological Impact Assessment in the UK and Ireland*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal

				• Impact assessment
				  o Assess whether important ecological features will be subject to impacts and characterise these impacts and their effects (including scale, duration and significance).
				  o Assess the residual ecological impacts of the project remaining after mitigation and the significance of their effects, including cumulative effects.
				• Avoidance, mitigation, compensation and enhancement
				  o Identify and incorporate measures to avoid, reduce and compensate ecological impacts, and the provision of ecological enhancements.
				  o Detail proposals for monitoring impacts of the development and evaluation of the success of proposed mitigation, compensation and enhancement measures.
				• Advice for decision makers:
				  o Provide advice on the consequences for decision making of the significant ecological impacts, based on the value of the affected resource or feature and consideration of the legal and policy framework throughout the impact assessment process.

				Draft NPS including Exclusionary Criteria: Positive effects on biodiversity associated with this reasonable alternative are expected to be similar to those identified in respect of the draft NPS, although the magnitude of effect will be greater. This reflects the expectation that the exclusion of siting of geological disposal infrastructure within internationally designated nature conservation sites will help to avoid/lessen adverse impacts on these assets, providing greater certainty with respect to the location of development. However, simply excluding works from within a designated conservation area would not necessarily exclude the possibility of adverse effects occurring (although the general risk of adverse effects is assumed to be reduced). Adverse effects could arise if the development was sited adjacent or close to the boundary of the designated conservation area, or if the reasons for the designation included mobile species (such as bats or migratory birds) who used extended areas for foraging or breeding. In addition, unintended effects could be produced as a consequence, such as greater development pressure on areas peripheral to excluded areas and/or local assets not given specific protection. In any case, existing national planning policy, legislation and the environmental permitting regime, together with the requirements of the draft NPS (as proposed), provide for the protection of designated nature conservation sites such that it can be reasonably expected that the potential for adverse impacts in this regard would be fully considered at the project stage. Even where there is the potential for adverse impacts to arise as a result of the development of geological disposal infrastructure, in many cases it is likely that these impacts could be avoided, minimised or mitigated through, for example, design measures (and in accordance with the provisions of the draft NPS).
				No NPS: Whilst applications would be subject to the provisions of national planning policy, EIA and HRA Regulations under this alternative and which would therefore still be considered to have a positive effect against the biodiversity assessment objective, the absence of a clear statement of the full range of considerations to be taken into account (as proposed in the NPS) risks inconsistency in interpretation, particularly at a project level.
Decision Making				

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Introductory section including overarching strategy & policy	**+**	**++/?**	**+/?**	**Draft NPS:** A hierarchy of policy considerations is set out which would entail the consideration of biodiversity interests at all stages in the decision-making process. A general principle is established that development should avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives. Emphasis is given to the importance of international and national designations, based on their biodiversity and nature conservation importance. As such, the likely effects are positive and impacts will be sought to be minimised, in line with the responsibilities under the Habitats Directive, although broader strategic development considerations, such as the need for the facility, could override biodiversity interests in protected areas.
				Draft NPS including Exclusionary Criteria: Setting clear exclusions for siting which specifically excludes landscape, cultural and natural heritage assets from the outset would help to establish clearer parameters for decision making and would have significant positive effects on biodiversity and nature conservation. However, as noted above, simply excluding works from within a designated conservation area would not necessarily exclude the possibility of adverse effects occurring (although the general risk of adverse effects is assumed to be reduced). Adverse effects could arise if the development was sited adjacent or close to the boundary of the designated conservation area, or if the reasons for the designation included mobile species (such as bats or migratory birds) who used extended areas for foraging or breeding. In addition, unintended effects could be produced as a consequence, such as greater development pressure on areas peripheral to excluded areas and/or local assets not given specific protection. In any case, existing national planning policy, legislation and the environmental permitting regime, together with the requirements of the draft NPS (as proposed), provide for the protection of designated nature conservation sites such that it can be reasonably expected that the potential for adverse impacts in this regard would be fully considered at the project stage. Even where there is the potential for adverse impacts to arise as a result of the development of geological disposal infrastructure, in many cases it is likely that these impacts could be avoided, minimised or mitigated through, for example, design measures (and in accordance with the provisions of the draft NPS).
				No NPS: Whilst applications will be subject to the provisions of national planning policy, EIA and HRA Regulations which would still be considered to have a positive effect against the biodiversity assessment objective, the absence of a clear statement of the full range of considerations to be taken into account (as proposed in the draft NPS) risks inconsistency in interpretation, particularly at a project level.
Protected Sites and Features (International Sites, SSSIs, MCZs, Regional and Local Sites, Ancient Woodlands and Veteran Trees)	**+**	**++/?**	**+/?**	**Draft NPS:** The specification of expectations for the consideration of the interests of protected areas (international, national and local) should lead to positive effects, although decision making will seek to balance competing interests, potentially leaving certain assets vulnerable to overriding influences such as the need for the facility.
				Draft NPS including Exclusionary Criteria: Whilst the draft NPS gives consideration to protected sites, setting clear exclusions for siting which specifically excludes landscape, cultural and natural heritage assets from the outset should help to establish clearer parameters for decision making and will have significant positive effects on the biodiversity. However, as noted above, simply excluding works from within a designated conservation area would not necessarily exclude the possibility of adverse effects occurring (although the general risk of adverse effects is assumed to be reduced). Adverse effects could arise if the development were sited adjacent or close to the boundary of the designated conservation area, or if

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				the reasons for the designation included mobile species (such as bats or migratory birds) who used extended areas for foraging or breeding. In addition, unintended effects could be produced as a consequence, such as greater development pressure on areas peripheral to excluded areas and/or local assets not given specific protection. In any case, existing national planning policy, legislation and the environmental permitting regime, together with the requirements of the draft NPS (as proposed), provide for the protection of designated nature conservation sites such that it can be reasonably expected that the potential for adverse impacts in this regard would be fully considered at the project stage. Even where there is the potential for adverse impacts to arise as a result of the development of geological disposal infrastructure, in many cases it is likely that these impacts could be avoided, minimised or mitigated through, for example, design measures (and in accordance with the provisions of the draft NPS).
				No NPS: Whilst applications will be subject to the provisions of national planning policy, EIA and HRA Regulations which would still be considered to have a positive effect against the biodiversity assessment objective, the absence of a clear statement of the full range of considerations to be taken into account (as proposed in the draft NPS) risks inconsistency in interpretation, particularly at a project level.
Biodiversity within and around developments & Protection of Other Habitats and Species	**++**	**++**	**+/?**	**Draft NPS:** The clear statement of the expectations and potential associated with good design and planning obligations to mitigate and offset impacts as a specific aspect of any application for development is likely to lead to significant positive effects. This could be further enhanced through cross-reference to the contents of the Mitigation section.
				Draft NPS including Exclusionary Criteria: The clear statement of the expectations and potential associated with good design and planning obligations to mitigate and offset impacts as a specific aspect of any application for development is likely to lead to significant positive effects.
				No NPS: Whilst being covered to a degree through the planning application process and national planning policy and hence positive effects, the absence of clear expectations as to design and planning obligations could lead to uncertainty and inconsistency in their application.
Mitigation	**+/?**	**+/?**	**+/?**	**Draft NPS:** The proposed mitigation sets out the minimum expectations associated with development and those which are commonly attached as conditions to a large development consent application. Positive effects are likely but they miss a significant opportunity to properly reflect the aspirations set out in the Assessment and Decision Making sections for biodiversity enhancement which goes beyond making good, or seeking to compensate for, what has been damaged.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Recommendations for Improvement The mitigation could be revised to be more specific and clearly reflect the key project stages of site investigation, construction, operation and closure, as follows[42]: *Site Investigation* Adverse effects during the siting process would mainly arise as a result of the borehole drilling programme and associated activities. With sensitive selection of drilling sites, there is a high potential for effective mitigation and site restoration. There is potential for very short-term minor disturbance to wildlife during aerial and geophysical surveys, but these would not cause any long-term or significant adverse effect. Advance desk-based studies and surveys should enable the avoidance of effects on the most sensitive locations. The nature of the investigation works means that there is significant potential for mitigation and for site restoration once the works are complete. Mitigation should therefore involve: • Full consideration of effects on biodiversity, flora and fauna and ecosystem services in the GDF siting process, in line with EIA. • Design/implement all geophysical and borehole surveys within the context of an environmental management plan. • Identify any designated sites, sensitive habitats and records of protected species ahead of any surveys and avoid sensitive locations and times of the year as far as possible. • Reinstate working sites to ensure that habitats are returned to their previous condition or better, with appropriate aftercare. If reinstatement cannot be achieved, provide compensatory habitat creation measures. *Construction* The effects of constructing a GDF could be direct (e.g. direct loss of biodiversity to hard engineering or access roads due to land take) or indirect (e.g. changes in environment affecting habitats and species due for example to alterations in drainage patterns, deposition of pollutants or the effects arising from disturbance). Surface disturbance could vary for different rock types, and this may reduce any potential biodiversity effects. The longer term nature of the occupation of the site means that mitigation work would focus on habitat replacement or enhancement on land surrounding a GDF rather than habitat restoration in its original location. Mitigation could therefore involve: • A new construction phase environmental management plan(s), including specific attention to matters such as transport access arrangements and opportunities for habitat enhancement on- and off-site, potentially as part of Green Infrastructure and biodiversity off-setting measures as agreed with appropriate regulators.

[42] Derived from: Radioactive Waste Management Limited (December 2016) *Geological Disposal Generic Environmental Assessment*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• Detailed design and layout of a GDF to seek to retain or minimise loss of any valuable biodiversity habitats and species and retain any linkages (corridors) between areas that could become isolated, as well as proposals for restoration following completion of construction works. • If retention or other adequate mitigation cannot be achieved, then compensatory replacement habitat may be required offsite, potentially in tandem with landscape measures. *Operation & Closure* Adverse effects during operation would be more limited than construction, and principally related to site management (e.g. disturbance from operational noise and light pollution, the risk of accidental pollution incidents and water management). These could be controlled through initial site design and through environmental management plans. Ongoing maintenance of biodiversity mitigation/enhancement features and monitoring of their success would be key activities. The initial stages of the closure process have the potential to cause adverse effects similar to construction and operation, although generally on a smaller scale. The final stage of closure is the restoration of the site is close as possible to its pre-GDF state – or to an alternative end-state agreed with the local community. Given that any landscape, ecological planting or habitat creation works could largely be retained, and that there would be many decades to mature and gain value; there is the potential to recreate an environment of greater value than the one originally lost, depending on the nature of the final end-state agreed with the local community. Surface activities in support of backfilling and accidental release of substances may cause indirect effects (e.g. disturbance/displacement of fauna from the site and environs). However, these activities would be similar or lesser in scale and nature to the proposed operational activities. Mitigation could therefore involve: For site operation, in addition to the continuation of the above: • A new, operational-phase environmental management plan. • Ongoing management and maintenance of any biodiversity mitigation features on site (e.g. any created habitat etc.) throughout the lifetime of a GDF. • Monitoring to determine the effectiveness of mitigation measures (commencing immediately after their establishment in the construction phase), with additional remedial measures if they are not achieving defined targets. For site closure, in addition to the continuation of the above: • Pre-closure ecological surveys. • Engagement with local stakeholders re desirable outcomes for biodiversity from site restoration, in the context of prevailing environmental conditions. • Restoration of the site to its pre-development condition so far as possible, or better, modified as appropriate in the

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				light of the preceding point (unless an alternative end state has been agreed with the local community). • Appropriate aftercare/ management arrangements to ensure the long-term success of the biodiversity mitigation and reinstatement works.
				Draft NPS including Exclusionary Criteria: The specification of exclusionary criteria is unlikely to make a difference to the application of the mitigation and enhancement measures as set out for the NPS above, and as such the predicted effects are likely to be similar.
				No NPS: Appropriate mitigation measures will be considered by the competent authority in light of the proposals submitted. As such, mitigation measures will be applied but there is the risk that this is open to interpretation and thereby does not fully address an appropriate range of activities which are directly related to the scheme rather than generic in character which serve the interests of biodiversity and nature conservation.
Other Sections of the Draft NPS Relevant to Biodiversity and Nature Conservation	**1. Introduction** 1.1.3 There is an opportunity for the consideration of effects on biodiversity in a specific locality through the preparation of a local impact report submitted by a local authority in accordance with the Planning Act. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on biodiversity as an issue, helping to ensure that consideration is given to likely effects in a particular locality. 1.1.4 Protection of biodiversity interests is reflected in the need to apply the NPS in the context of international obligations and to balance adverse impacts and benefits. The net result of this balancing exercise could be uncertain, however. 1.1.7 The generic impacts considered in the NPS, along with the application of the draft NPS as a material consideration on a case by case basis, could result in uncertainty over what provisions will be applied in respect of the protection of biodiversity interests and the mitigation of adverse effects. **1.4 Consideration of deep boreholes investigations** – the role and content of an Environmental Statement, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of biodiversity interests, avoiding or reducing harm and providing appropriate mitigation where required. **1.5 Consideration of geological disposal facilities** – the spatial disposition of facilities and the timescale of development could affect biodiversity interests although the requirements for limiting cumulative negative impacts within safety and reasonable financial constraints should help to minimise impacts. However the net long-term effects remain uncertain. **1.7. Habitats considerations** - the identification of the application of the HRA to the draft NPS will help ensure that the interests of European sites are given proper consideration, notwithstanding the fact that there remains uncertainly over potential impacts, particularly in respect of the absence of specific locations and likely effects within the draft NPS. **2. Government Policy on Management of Higher Activity Radioactive Waste** 2.2.6. The preference for disposal through a single site will help to confine effects to a specific area thus limiting effects on biodiversity, although these could still be significant in respect of that particular site. 2.4.3 The strategy for implementation provides for the opportunity to consider biodiversity interests as the process proceeds iteratively, including discussions with			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	communities of interest. **3. The Need for Geological Disposal Infrastructure** The identification of technical and ethical considerations which prompt the need to provide for a GDF will benefit biodiversity interests through the adoption of a responsible approach to waste disposal. As such, this lessens risk to biodiversity interests over a wide area through potential leakage of radioactive materials (for various reasons). **4. Assessment Principles** **4.1 General principles of assessment** - the provisions of the Planning Act and the policies and protections set out in the NPS provide for a balanced consideration of needs. The requirement for the identification of adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for the protection and enhancement of biodiversity interests. **4.2 Environmental Impact Assessment** – the consideration of proposals within the EIA Regulations and the preparation of an Environmental Statement (where required) agreed by statutory agencies and specifying mitigation and enhancement measures will ensure that biodiversity interests are fully considered, as will the consideration of cumulative effects and interrelationships between effects. **4.3 Habitats Regulations Assessment** – the interests of biodiversity habitats and species of European importance are fully considered through the requirement for the consideration of likely significant effects through a HRA and involvement with statutory agencies. **4.4 Alternatives** – the identification that reasonable alternatives will be required as part of scheme design and project planning should ensure that biodiversity interests are taken into account, both in terms of protection and opportunities for mitigation and enhancement. **4.5 Criteria for good design for geological disposal infrastructure** - attention to good design principles and implementation will be of benefit to biodiversity interests through the consideration of how a proposed facility interacts with its context. As drafted, however, the draft NPS could offer a fuller explanation of how this might be achieved, moving beyond the reference points of 'landform' and 'vegetation' to the integration of biodiversity interests on site as part of a scheme, as well as broader mitigation measures. Attention should also be paid to the lifecycle of the scheme development and how biodiversity interests can be accommodated throughout, and particularly as part of site closure. **4.6 Climate Change Adaptation** – adaptation measures could be required which impinge upon biodiversity interests although with appropriate design and mitigation measures these could be of mutual benefit (for example in relation to coastal habitat management). **4.7 Pollution Control and other Environmental Regulatory Regimes** – the various planning and pollution control systems will act to protect biodiversity interests, particularly where these are to be considered as part of the judgement on whether the development is an acceptable use of the land, the impacts of that use, with the assumption that pollution control will be properly applied and enforced. **4.80 Common Law Nuisance and Statutory Nuisance** – no direct relationship identified. **4.9 Safety** – no direct relationship identified. **4.10 Health** – no direct relationship identified **4.11 Security Considerations** – no direct relationship identified.			
Summary Appraisal of	**+**	**++**	**+/?**	**Draft NPS:** Application of the draft NPS is likely to result in positive effects in respect of the protection and enhancement of biodiversity interests, reflecting the specification of the parameters associated with site investigation, construction and

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Likely Significant Effects				operation of a GDF. The draft NPS framework will be applied in light of existing legislation at international and national levels in principle protecting biodiversity and nature conservation interests, although this will be a balancing exercise reflecting national need and other considerations. Development will affect biodiversity interests to some degree at various points in the project lifecycle, but the NPS provides for the application of clear mitigation measures, addressing direct and indirect effects, and promoting conservation and enhancement of biodiversity interests, resulting in positive effects. The wider considerations of the draft NPS in respect of the assessment principles such as EIA & HRA, good design, pollution control is likely to result in positive effects.
				Draft NPS including Exclusionary Criteria: The overall effects of the inclusion of exclusionary criteria within the NPS are likely to be similar to those relating to the draft NPS, although the magnitude will be greater. This reflects the expectation that the exclusion of siting of geological disposal infrastructure within internationally designated nature conservation sites will help to avoid/lessen adverse impacts on these assets, providing greater certainty with respect to the location of development. However, simply excluding works from within a designated conservation area would not necessarily exclude the possibility of adverse effects occurring (although the general risk of adverse effects is assumed to be reduced). Adverse effects could arise if the development were sited adjacent or close to the boundary of the designated conservation area, or if the reasons for the designation included mobile species (such as bats or migratory birds) who used extended areas for foraging or breeding. In addition, unintended effects could be produced as a consequence, such as greater development pressure on areas peripheral to excluded areas and/or local assets not given specific protection. In any case, existing national planning policy, legislation and the environmental permitting regime, together with the requirements of the draft NPS (as proposed), provide for the protection of designated nature conservation sites such that it can be reasonably expected that the potential for adverse impacts in this regard would be fully considered at the project stage. Even where there is the potential for adverse impacts to arise as a result of the development of geological disposal infrastructure, in many cases it is likely that these impacts could be avoided, minimised or mitigated through, for example, design measures (and in accordance with the provisions of the draft NPS).
				No NPS: Despite the absence of a guiding framework for biodiversity interests, there are likely to be positive effects overall, reflecting the application of international and national legislation protecting habitats and species. However, the absence of clear expectations as to design and planning obligations relating the specific case of a GDF could lead to uncertainty and inconsistency in their application and missed opportunities for habitat creation and enhancement. The precise range of mitigation applied as part of any scheme development would potentially be less certain and with greater inconsistency than under a NPS.
Summary of Recommended Mitigation and Enhancement	The mitigation measures proposed by the draft NPS reflect those expected to be set out as part of the conditions attached to any application. They could more fully reflect the specification set out in the Applicant's Assessment and Decision Making Criteria and relate more specifically to project stages (site investigation, construction, operation & closure) and thereby the likely specific impacts associated with a development of this nature. These would establish a clear specification for use by applicant and appraisal by the competent authority. Equally, there could be more attention paid to specific design principles associated with the project lifecycle and by implication the mitigation measures which can reasonably be applied.			

Annex A

Table A.1 Species Used to Calculate Wild Bird Population Indices

Woodland Birds	Waterbirds	Seabirds	Farmland Birds	Other Species
Blackbird (Turdus merula)	*Common sandpiper (Actitis hypoleucos)*	*Arctic skua (Stercorarius parasiticus)*	*Greenfinch (Carduelis chloris)*	*Avocet (Recurvirostra avosetta)*
Blue tit (Cyanistes caeruleus)	*Dipper (Cinclus cinclus)*	*Arctic tern (Sterna paradisaea)*	*Jackdaw (Corvus monedula)*	*Bearded tit (Panurus biarmicus)*
Bullfinch (Pyrrhula pyrrhula)	*Goosander (Mergus merganser)*	*Black-legged kittiwake (Rissa tridactyla)*	*Kestrel (Falco tinnunculus)*	*Black-headed gull (Chroicocephalus ridibundus)*
Chaffinch (Fringilla coelebs)	*Grey wagtail (Motacilla cinerea)*	*Common guillemot (Uria aalge)*	*Reed bunting (Emberiza schoeniclus)*	*Buzzard (Buteo buteo)*
Dunnock (Prunella modularis)	*Coot (Fulica atra)*	*Common tern (Sterna hirundo)*	*Rook (Corvus frugilegus)*	*Carrion crow (Corvus corone)*
Great tit (Parus major)	*Great-crested grebe (Podiceps cristatus)*	*European shag (Phalacrocorax aristotelis)*	*Woodpigeon (Columba palumbus)*	*Cirl bunting (Emberiza cirlus)*
Lesser whitethroat (Sylvia curruca)	*Little grebe (Tachybaptus ruficollis)*	*Great black-beaked gull (Larus marinus)*	*Yellow wagtail (Motacilla flava)*	*Collared dove (Streptopelia decaocto)*
Long-tailed tit (Aegithalos caudatus)	*Mallard (Anas platyrhynchos)*	*Great cormorant (Phalacrocorax carbo)*	*Corn bunting (Emberiza calandra)*	*Corncrake (Crex crex)*
Robin (Erithacus rubecula)	*Moorhen (Gallinula chloropus)*	*Herring gull (Larus argentatus)*	*Goldfinch (Carduelis carduelis)*	*Cuckoo (Cuculus canorus)*
Song thrush (Turdus philomelos)	*Cetti's warbler (Cettia cetti)*	*Little tern (Sternula albifrons)*	*Grey partridge (Perdix perdix)*	*Dartford warbler (Sylvia undata)*
Tawny owl (Strix aluco)	*Reed bunting (Emberiza schoeniclus)*	*Northern fulmar (Fulmarus glacialis)*	*Lapwing (Vanellus vanellus)*	*Firecrest (Regulus ignicapilla)*
Wren (Troglodytes troglodytes)	*Reed warbler (Acrocephalus Scirpaceus)*	*Razorbill (Alca torda)*	*Linnet (Carduelis cannabina)*	*Gadwall (Anas strepera)*
Blackcap (Sylvia atricapilla)	*Sedge warbler (Acrocephalus Schoenobaenus)*	*Sandwich tern (Sterna sandvicensis)*	*Skylark (Alauda arvensis)*	*Golden plover (Pluvialis apricaria)*
Chiffchaff (Phylloscopus collybita)	*Curlew (Numenius arquata)*		*Starling (Sturnus vulgaris)*	*Greylag goose (Anser anser)*
Coal tit (Periparus ater)	*Lapwing (Vanellus vanellus)*		*Stock dove (Columba oenas)*	*Hen harrier (Circus cyaneus)*
Garden warbler (Sylvia borin)	*Little egret (Egretta garzetta)*		*Tree sparrow (Passer montanus)*	*Hobby (Falco subbuteo)*
Goldcrest (Regulus regulus)	*Redshank (Tringa totanus)*		*Turtle dove (Streptopelia turtur)*	*Hooded crow (Corvus cornix)*
Great spotted woodpecker (Dendrocopos major)	*Snipe (Gallinago gallinago)*		*Whitethroat (Sylvia communis)*	*House martin (Delichon urbicum)*
Green woodpecker (Picus viridis)	*Teal (Anas crecca)*			*House sparrow (Passer domesticus)*
Jay (Garrulus glandarius)	*Yellow wagtail (Motacilla flava)*			*Magpie (Pica pica)*
Lesser spotted woodpecker	*Grey Heron (Ardea Cinerea)*			*Meadow pipit (Anthus pratensis)*

Woodland Birds	Waterbirds	Seabirds	Farmland Birds	Other Species
(Dendrocopos minor)				
Marsh tit (Poecile palustris)	*Kingfisher (Alcedo Atthis)*			*Mediterranean gull (Larus melanocephalus)*
Nightingale (Lusciniamegarhynchos)	*Oystercatcher (Haematopus Ostralegus)*			*Mistle thrush (Turdus viscivorus)*
Nuthatch (Sitta europaea)	*Sand Martin (Riparia Riparia)*			*Peregrine (Falco peregrinus)*
Lesser redpoll (Carduelis cabaret)	*Tufted duck (Aythya fuligula)*			*Pied/white wagtail (Motacilla alba)*
Redstart (Phoenicurusphoenicurus)	*Mute swan (Cygnus olor)*			*Pochard (Aythya ferina)*
Sparrowhawk (Accipiter nisus)				*Quail (Coturnix coturnix)*
Spotted flycatcher (Muscicapa striata)				*Raven (Corvus corax)*
Tree pipit (Anthus trivialis)				*Red-breasted merganiser (Mergus serrator)*
Treecreeper (Certhia familiaris)				*Red grouse (Lagopus lagopus scotica)*
Willow tit (Poecile montana)				*Red kite (Milvus milvus)*
Willow warbler (Phylloscopus trochilus)				*Shelduck (Tadorna tadorna)*
Pied flycatcher (Ficedula hypoleuca)				*Shoveler (Anas clypeata)*
Wood warbler (Phylloscopus sibilatrix)				*Stonechat (Saxicola rubicola)*
Common crossbill (Loxia curvirostra)				*Swallow (Hirundo rustica)*
Siskin (Carduelis spinus)				*Swift (Apus apus)*
Capercaillie (Tetrao urogallus)				*Whinchat (Saxicola rubetra)*
				Woodlark (Lullula arborea)

Table A.2 Species Used to Calculate the Wintering Waterbird Measure

Anas acuta (Pintail)	*Branta bernicla hrota (Svalbard light-bellied brent goose)*	*Limosa limosa (Black-tailed godwit)*
Anas clypeata (Shoveler)	*Branta bernicla hrota (Nearctic light-bellied brent goose)*	*Mergus merganser (Goosander)*
Anas crecca (Teal)	*Branta leucopsis (Svalbard barnacle goose)*	*Mergus serrator (Red-breasted merganser)*
Anas penelope (Wigeon)	*Branta leucopsis* (Greenland barnacle goose)	*Numenius arquata* (Curlew)
Anas platyrhynchos (Mallard)	*Bucephala clangula* (Goldeneye)	*Phalacrocorax carbo* (Cormorant)
Anas strepera (Gadwall)	*Calidris alba* (Sanderling)	*Pluvialis apricaria* (Golden plover)
Anser albifrons (European white-fronted goose)	*Calidris alpine* (Dunlin)	*Pluvialis squatarola* (Grey plover)
Anser albifrons flavirostris (Greenland white-fronted goose)	*Calidris canuta* (Knot)	*Podiceps cristatus* (Great crested grebe)
Anser anser (Greylag goose - Icelandic population)	*Calidris maritime* (Purple sandpiper)	*Recurvirostra avosetta* (Avocet)
Anser anser anser (British/Irish greylag goose)	*Charadrius hiaticula* (Ringed plover)	*Somateria mollissima* (Eider)
Anser brachyrhynchus (Pink-footed goose)	*Cygnus columbianus* (Bewick's swan)	*Tachybaptus ruficollis* (Little grebe)
Arenaria interpres (Turnstone)	*Cygnus* (Whooper swan)	*Tadorna* (Shelduck)
Aythya farina (Pochard)	*Cygnus olor* (Mute swan)	*Tringa tetanus* (Redshank)
Aythya fuligula (Tufted duck)	*Fulica atra* (Coot)	*Vanellus* (Lapwing)
Aythya marila (Scaup)	*Haematopus ostralegus* (Oystercatcher)	
Branta bernicla (Dark-bellied brent goose)	*Limosa lapponica* (Bar-tailed godwit)	

Table A.3 Species Used to Calculate Butterfly Population Indices

Generalist Butterflies	Habitat Specialist Butterflies
Aglais io (Peacock)	*Apatura iris* (Purple emperor)
Aglais urticae (Small tortoiseshell)	*Argynnis adippe* (High brown fritillary)
Anthocharis cardamines (Orange-tip)	*Argynnis aglaja* (Dark green fritillary)
Aphantopus hyperantus (Ringlet)	*Argynnis paphia* (Silver-washed fritillary)
Aricia agestis (Brown argus)	*Aricia artaxerxes (*Northern brown argus)
Celastrina argiolus (Holly blue)	*Boloria euphrosyne* (Pearl-bordered fritillary)
Coenonympha pamphilus (Small heath)	*Boloria selene* (Small pearl-bordered fritillary)
Erebia aethiops (Scotch argus)	*Callophrys rubi* (Green hairstreak)
*Favonius quercus (*Purple hairstreak)	*Coenonympha tullia* (Large heath)
Gonepteryx rhamni (Brimstone)	*Cupido minimus* (Small blue)
Lasiommata megera (Wall)	*Erynnis tages* (Dingy skipper)
Lycaena phlaeas (Small copper)	*Euphydryas aurinia* (Marsh fritillary)
Maniola jurtina (Meadow brown)	*Hamearis lucina* (Duke of Burgundy)
Melannargia galathea (Marbled white)	*Hesperia comma* (Silver-spotted skipper)
Ochlodes sylvanus (Large skipper)	*Hipparchia semele* (Grayling)
Pararge aegeria (Speckled wood)	*Leptidea sinapis* (Wood white)
Pieris brassicae (Large white)	*Limenitis camilla* (White admiral)
Pieris napi (Green-veined white)	*Melitaea athalia* (Heath fritillary)
Pieris rapae (Small white)	*Papilio machaon* (Swallowtail)
Polygonia c-album (Comma)	*Plebeius argus* (Silver-studded blue)
Polyommatus icarus (Common blue)	*Polyommatus bellargus* (Adonis blue)
Pyronia tithonus (Gatekeeper)	*Polyommatus coridon* (Chalkhill blue)
Satyrium w-album (White-letter hairstreak)	*Pyrgus malvae* (Grizzled skipper)
Thymelicus sylvestris/lineola (Small/Essex skipper)	*Satyrium pruni* (Black hairstreak)
	Thecla betulae (Brown hairstreak)
	Thymelicus acteon (Lulworth skipper)

2. Population, Economics and Skills

Introduction

This section presents the overview of plans, programmes and baseline information for the appraisal of sustainability of the National Policy Statement for Geological Disposal Infrastructure and reasonable alternatives in respect of population, economics and skills.

There are links between the population, economics and skills topic and a number of other topics in the Appraisal of Sustainability (AoS), in particular human health, traffic and transport, air quality and climate change.

Review of Plans and Programmes

The review identified a range of plans and programmes that seek to enhance the economy of the UK and ensure that the economy develops in accordance with the principles of sustainable development. They provide the context for economic growth for the country, with an associated increase in the demand for natural resources. The *National Infrastructure Delivery Programme* sets out support for new nuclear power stations which would generate additional radioactive waste requiring disposal. The plans and programmes also highlight the need to maintain appropriately skilled workers and a supply chain which can support the nuclear industry.

International/European

The United Nations ***World Summit on Sustainable Development (2002)*** resulted in the Johannesburg Declaration on Sustainable Development, which reaffirmed the Millennium Development Goals and addresses issues such as poverty and economic development.

Europe 2020 (2010*)** is Europe's economic growth strategy. It aims to deliver growth that is smart, sustainable and inclusive and sets objectives on employment, innovation, education, social inclusion and climate/ energy - to be reached by 2020. ***The European Employment Strategy (1997), also known as the Luxembourg process provides a set of common objectives and targets for employment policy. Its main aim is the creation of more and better jobs throughout the EU, as well as increasing productivity and the promotion of inclusion by addressing disparities in access to labour markets. It now constitutes part of the Europe 2020 growth strategy and it is implemented through the European semester, an annual process promoting close policy coordination among EU Member States and EU Institutions. These overarching aims are further espoused in the ***Europe 2020 Integrated Guidelines (2015)***, which give guidance to Member States on implementing reforms. Key social and economic initiatives under the strategy include the *'Agenda for new skills and growth'* and the *'European platform against poverty'*. Alongside reducing poverty, these plans and programme also seek to reduce income inequality.

The ***EU Sustainable Development Strategy*** adopted in 2001 and reviewed in 2006 and 2009 also includes indicators relating to economic development and employment rates.

The United Nation's ***Aarhus Convention (2001)*** grants the public rights and imposes on parties and public authority's obligations regarding access to information, public participation and access to justice. It contains three broad themes or 'pillars':

- access to information;

- public participation; and
- access to justice.

The ***SEA Directive (2001/42/EC)*** sets out the following requirements for public consultation:

- Authorities which, because of their environmental responsibilities, are likely to be concerned by the effects of implementing the plan or programme, must be consulted on the scope and level of detail of the information to be included in the Environmental Report. These authorities are designated in the SEA Regulations as the Consultation Bodies;
- The public and the Consultation Bodies must be consulted on the draft plan or programme and the Environmental Report, and must be given an early and effective opportunity within appropriate time frames to express their opinions;
- Other EU Member States must be consulted if the plan or programme is likely to have significant effects on the environment in their territories; and
- The Consultation Bodies must also be consulted on screening determinations on whether SEA is needed for plans or programmes under Article 3(5), i.e. those which may be excluded if they are not likely to have significant environmental effects.

UK

Securing the Future – the UK Sustainable Development Strategy (2005) aims to enable all people throughout the world to satisfy their basic needs and enjoy a better quality of life without compromising the quality of life of future generations. The Strategy has five guiding principles:

- living within environmental limits;
- ensuring a strong, healthy and just society;
- achieving a sustainable economy;
- promoting good governance; and
- using sound science responsibly.

The UK Government's ***Plan for Growth (2011)*** announced a programme of structural reforms to remove barriers to growth for businesses and equip the UK to compete in the global race. These reforms span a range of policies including improving UK infrastructure, cutting red tape, root and branch reform of the planning system and boosting trade and inward investment, to achieve the Government's four ambitions for growth:

- creating the most competitive tax system in the G20;
- encouraging investment and exports as a route to a more balanced economy;
- making the UK the best place in Europe to start, finance and grow a business; and
- creating a more educated workforce that is the most flexible in Europe.

In 2015, the UK Government launched ***Fixing the Foundations: Creating a More Prosperous Nation*** which aims to increase growth through higher productivity. This approach includes long-term investment in skills and businesses as well as flexible and competitive markets.

The UK's reform plans for promoting growth and employment to meet the Europe 2020 goals are set out in ***Europe 2020: UK National Reform Programme 2015 (2015)***.

In 2016, the UK Government published an updated ***National Infrastructure Delivery Plan***. This sets out the Government's plan to 2021 and beyond and takes a targeted approach to infrastructure investment and delivery across different sectors. It contains major commitments to improve the UK's transport, energy, communications, waste, water, housing and science and research infrastructure as well as steps to attract new private sector investment.

The ***Nuclear Decommission Authority (NDA) Strategy (2016)*** sets out the strategic direction and long-term objectives for the organisation, and includes strategies for People, Supply Chain Development and Socio-economics. The People strategy has the objective to: "attract and retain the necessary skills, diversity of talent and capability to deliver the NDA mission efficiently and effectively". The Supply Chain strategy aims to: "ensure that the supply chain available to the NDA estate is optimised to enable a safe, affordable, cost effective, innovative and dynamic market to support our mission", while the Socio-economics objective is to: "support the maintenance of sustainable local economies for communities living near our sites and, where possible, contribute to regional economic growth objectives".

England

The ***Local Growth White Paper (2010)*** sets out the Government's overarching goal to promote strong, sustainable and balanced growth. It restates the Government's role in providing the framework for conditions for sustainable growth by:

- creating macroeconomic stability, so that interest rates stay low and businesses have the certainty they need to plan ahead;
- helping markets work more effectively, to encourage innovation and the efficient allocation of resources;
- ensuring that it is efficient and focused in its own activities, prioritising high-value spending and reducing tax and regulatory burdens; and
- ensuring that everyone in the UK has access to opportunities that enable them to fulfil their potential.

The White Paper focuses on the approach to local growth proposing measures to shift power away from central government to local communities, citizens and independent providers. In particular, it introduced Local Enterprise Partnerships (LEPs) to provide a vision and leadership for sustainable local economic growth. The number of LEPs has increased from the 24 originally announced to 39. The Local Growth Fund gives LEPs access to central government funding, ensuring that this money is spent in line with local priorities.

The Green Paper ***Building our Industrial Strategy (2017)*** acts as a starting point in an ongoing consultation on the government's developing industrial strategy. It is based around 10 pillars: science, research and innovation; skills; infrastructure; business growth and investment; procurement; trade and investment; affordable energy; sectoral policies; driving growth across the whole country; and creating the right institutions to bring together sectors and places. The strategy highlights skill shortages in the nuclear industry and support for Hinkley Point C.

The ***National Planning Policy Framework (2012)*** sets out the core land-use principles to deliver sustainable development. It notes the three dimensions to sustainable development: economic, social and environmental, and highlights the importance under the economic role of planning policy in ensuring that sufficient land of the right type is available in the right places

and at the right time to support growth and innovation; and by identifying and coordinating development requirements, including the provision of infrastructure.

Scotland

Scotland's Third National Planning Framework (2014) underlines the government's central purpose to create a more successful country for all of Scotland to flourish, through increasing sustainable economic growth. The NPF is underpinned by four interlinked visions which set out the planning strategy for Scotland. These visions are:

- A successful, sustainable place;
- A low carbon place;
- A natural, resilient place; and
- A connected place

Scotland's Economic Strategy (2015) sets out four strategic priorities which are intended to help increase competitiveness and tackle inequalities across the country. These priorities are:

- Investing in people and infrastructure in a sustainable way;
- Fostering a culture of innovation and research and development;
- Promoting inclusive growth and creating opportunity through a fair and inclusive jobs market; and
- Promoting Scotland on the international stage to boost trade and investment, influence and networks.

Scottish Planning Policy (2014) is a statement of Scottish Government policy on how nationally important land use planning matters should be addressed in Scotland. It promotes consistency in the application of policy across Scotland whilst allowing sufficient flexibility to reflect local circumstances. The seven core values of Scottish Planning Policy are:

- Focus on outcomes, maximising benefits and balancing competing interests;
- Play a key role in facilitating sustainable economic growth, particularly the creation of new jobs and the strengthening of economic capacity and resilience within communities;
- Be plan-led, with plans being up-to-date and relevant;
- Make decisions in a timely, transparent and fair way to provide a supportive business environment and engender public confidence in the system;
- Be inclusive, engaging all interests as early and effectively as possible;
- Be proportionate, only imposing conditions and obligations where necessary; and
- Uphold the law and enforce the terms of decisions made.

The Scottish Government's ***Regeneration Strategy: Achieving A Sustainable Future (2011)*** underlines the challenges faced by some of the most disadvantaged communities and the responses required to help create a Scotland where all places are sustainable, and where people want to live, work and invest. The regeneration of Scotland's most disadvantaged areas and strengthening of local communities are key priorities.

A Plan for Scotland: The Government's Programme for Scotland 2016-17 (2016) sets the actions the Scottish Government will take in 2016/17 and beyond. It focuses on an education system providing opportunities for all, an economy with more jobs and fair work, public services fit for the future and empowering people and communities.

Working for Growth: A Refresh of the Employability Framework for Scotland (2012) provides a clear framework to strengthen Scotland's focus on jobs and growth. It does so under the following themes:

- Strategy and Effective Leadership;
- Better Integration and Partnership Working;
- Towards Prevention - Tackling Inequality; and
- Improving Performance.

A report completed for the Scottish Government by the UK Commission for Employment and Skills (UKCES) entitled ***Towards Ambition 2020: skills, jobs, growth for Scotland (2009)*** found that Scotland's skills base has improved considerably but this has not translated into higher productivity and economic growth. In response to this, the Scottish Government prepared ***Skills for Scotland: Accelerating the Recovery and Increasing Sustainable Economic Growth (2010).*** This strategy focuses on the following four key themes:

- Empowering people;
- Supporting employers;
- Simplifying the skills system; and
- Strengthening partnerships.

The ***Scottish Government Gaelic Language Plan 2016-2021*** was published in 2017, and sets out how the Scottish Government supports Gaelic in its operations and promotes the development of Gaelic, to ensure the language has a sustainable future in Scotland.

Wales

The ***Well-being of Future Generations (Wales) Act 2015*** is focused on improving the social, economic, environmental and cultural well-being of Wales. The Act requires the public bodies listed in the Act to ensure that any action or process they carry out is done in a sustainable way, must maximise its contribution to well-being goals, and that when making decisions they take into account the impact those decisions could have on people living their lives in Wales in the future. The Act establishes seven well-being goals:

- a prosperous Wales;
- a resilient Wales;
- a healthier Wales;
- a more equal Wales;
- a Wales of cohesive communities;
- a Wales of vibrant culture and thriving Welsh language;
- a globally responsible Wales.

All relevant public bodies must take all reasonable steps (in exercising its functions) to meet those objectives.

Economic renewal: a new direction (2010) sets out the role that devolved government, in this case Wales, can play in providing the best conditions and framework to enable the private sector to grow and flourish. It is intended that government resources will be targeted at tackling wide systematic issues within the Welsh economy – investing in infrastructure, skills and improving the conditions within which businesses operate. Economic renewal will see a fundamental shift away from direct and generic support for companies to a focus on creating the right environment for businesses to succeed.

The ***Wales Infrastructure Investment Plan (2012)*** is intended to drive collaboration, increase visibility and deliver the strategic capital investment decisions. It notes that, infrastructure investment is one of its highest priorities and provides a much needed stimulus, creating the conditions for sustainable growth in the medium and longer term. The Plan is designed to prioritise, scope and coordinate delivery of our major infrastructure investments, whilst improving the long-term economic, social and environmental wellbeing of people and communities in Wales.

Taking Wales Forward 2016-2021 (2016) sets out the Welsh Government's programme to drive improvement in the Welsh economy and public services, delivering a Wales which is prosperous and secure, learning and connected. It includes support for businesses, the creation of apprenticeships and employability support.

The Welsh Government's ***Policy statement on skills (2014)*** sets out future policy actions which will enable Wales to evolve into a highly skilled nation. It is focused on employment and skills and covers four priority areas: skills for jobs and growth; skills that respond to local needs; skills that employer's value; and skills for employment. The objective of the statement is to create the right conditions for employers across Wales to thrive and prosper.

Cymraeg 2050: A Million Welsh Speakers (2017) is the Welsh Ministers' strategy for the promotion and facilitation of the use of the Welsh language. It is based around the three themes of:

1. increasing the number of Welsh speakers;
2. increasing the use of Welsh; and
3. creating favourable conditions – infrastructure and context.

The strategy aims to achieve this via several actions including making rapid progress to expand Welsh-medium early years provision by 150 nursery groups over the next decade; increasing the proportion of each school year group receiving Welsh-medium education from 22 percent to 40 percent by 2050; and reviewing the legislation that underpins the Welsh language.

Planning Policy Wales (9th Edition, 2016) sets out that the planning system should support economic and employment growth alongside social and environmental considerations within the context of sustainable development. To this end, the planning system, including planning policies, aims to ensure that the growth of output and employment in Wales as a whole is not constrained by a shortage of land for economic uses. Local planning authorities should aim to facilitate the provision of sufficient land required by the market, except where there are good reasons to the contrary, and with due regard to sustainable development. Planning Policy Wales contains sections on the following topics: planning for sustainability; conserving and improving natural heritage and the coast; the historic environment; economic development; transport; housing; planning for retail and commercial development; tourism, sport and

recreation; infrastructure and services; minimising and managing environmental risks and pollution; and minerals.

The ***Wales Spatial Plan: Places, Futures (2008)*** contains the following key themes which relate to population:

- building sustainable communities;
- promoting a sustainable economy; and
- respecting distinctiveness.

The ***Vibrant and Viable Places: New Regeneration Framework (2013)*** sets out the vision that everybody in Wales should live in well-connected vibrant, viable and sustainable communities with a strong local economy and good quality of life. The framework sets key priorities for regeneration investment in Wales.

Technical Advice Note 6 – Planning for Sustainable Rural Economies (2010) (TAN6) provides practical guidance on how the planning system can support sustainable rural communities. This guidance provides advice on: sustainable rural communities and economies; rural affordable housing; rural enterprise dwellings; one planet developments; sustainable rural services; and sustainable agriculture.

Technical Advice Note 12 – Design (2016) (TAN12) sets out the Welsh Government's policies and objectives in respect of the design of new development, including; ensuring attractive, safe public spaces and ensuring ease of access for all.

Technical Advice Note 13 – Tourism (1997) (TAN13) offers advice on hotel development, holiday and touring caravans and seasonal and holiday occupancy conditions. Tourism makes a major contribution to the Welsh economy and provides employment in a wide variety of occupations and can bring benefits to local communities in urban and rural areas.

Technical Advice Note 20 – Planning and the Welsh Language (2013) (TAN20) provides advice on the consideration of the Welsh language as part of the Local Development Plan making process. The TAN covers: the role of single integrated plans; the Welsh language and sustainability appraisals; the Welsh language commissioner; and signs and advertisements.

Technical Advice Note 23 – Economic Development (2014) (TAN23) is intended to help local planning authorities and developers implement national planning policy on economic development. TAN23 provides advice on the national planning policy on economic development set out in Planning Policy Wales. It provides guidance on: developing high level economic planning objectives; assessing the economic benefits of new development; economic development and the rural economy; preparing an evidence base for a Local Development Plan; creating an economic development vision for a Local Development Plan; and determining employment land supply.

Overview of the Baseline

UK

Demographics

In mid–2016, the resident population of Great Britain was 65,648,000 (49.3% male and 50.7% female), representing a gain of 538,000 (0.8%) over the previous year (this growth was similar to the average annual increase seen over the last decade). A total of 63.5% of the population

was of working age (aged 16 to 64)[43]. The UK's population has increased by over 6 million since 2000[44].

The working age population for the period May 2017 to July 2017 for the UK was broken down as follows[45]:

- 78.8% economically active, comprising:
  - 75.3% in employment[46]; and
  - 4.3% unemployed[47].
- 21.2% economically inactive.

Since May to July 2016, there was a 0.4% increase with regard to those in the working age population who were economically active, a 0.8% increase in employment and 0.6% reduction in those who are unemployed.

Education and Skills

The breakdown of qualifications of the working age population in 2016 was as follows:

- 38.0% had NVQ4 and above[48];
- 17.1% had NVQ3[49];
- 3.1% had trade apprenticeships;
- 15.9% had NVQ2[50];
- 10.9% had NVQ1[51];
- 6.6% had other qualifications; and
- 8.3 % had no qualifications.

The total number of higher education enrolments in the UK in 2015/16 increased by 1% from 2014/15, an increase for the first time in several years[52]. The sharpest year on year decrease in enrolments was observed between 2011/12 and 2012/13, at 6%, which coincided with changes in tuition fee arrangements.

In 2015/2016, the UK had a total of 32,142 schools, comprising:

- 3,007 nursery;
- 20,954 primary;

[43] ONS (2017) *United Kingdom population mid-year estimate*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/timeseries/ukpop/pop
[44] NOMIS (2016) *Population estimates - local authority based by five-year age band*. Available online at: https://www.nomisweb.co.uk/query/select/getdatasetbytheme.asp?opt=3&theme=&subgrp
[45] NOMIS (2017) *Labour Market Profile*. Available online at: https://www.nomisweb.co.uk/reports/lmp/gor/contents.aspx
46 % are for those aged 16-64.
47 % is a proportion of economically active.
[48] HND, Degree and Higher Degree level qualifications or equivalent
[49] 2 or more A levels, advanced GNVQ, NVQ 3, 2 or more higher or advanced higher national qualifications (Scotland) or equivalent
[50] 5 or more GCSEs at grades A-C, intermediate GNVQ, NVQ 2, intermediate 2 national qualification (Scotland) or equivalent
[51] Fewer than 5 GCSEs at grades A-C, foundation GNVQ, NVQ 1, intermediate 1 national qualification (Scotland) or equivalent.
[52] HESA (2017) *Higher education student enrolments and qualifications obtained at higher education providers in the United Kingdom 2015/16*. Available online at: https://www.hesa.ac.uk/news/12-01-2017/sfr242-student-enrolments-and-qualifications

- 7 middle;
- 4,169 secondary;
- 2,391 non-maintained mainstream;
- 1,261 special; and
- 353 pupil referral units[53].

Crime

In England and Wales, between March 2016 and 2017 estimates from the Crime Survey England and Wales (CSEW) indicate that robbery offences fell by the greatest proportion (17%). Most categories of theft showed a decline in incidents, with all CSEW crime falling by 7%.

Table 2.1 CSEW numbers of incidents for year ending March 2017[54]

Type of Crime	2016	2017	Change
	Number of Incidents (thousands)		%
Violence	1,268	1,240	-2
Robbery	154	129	-17
Theft from person	363	367	1
Other theft of personal property	764	641	-16
Domestic burglary	701	650	-7
Other household theft	672	587	-13
Vehicle-related theft	878	790	-10
Bicycle Theft	327	23	-11
Criminal Damage	1,209	48	-3
All CSEW (Crime Survey England & Wales) Crime	6,334	5,864	-7

Economic Baseline

In 2015, UK per capita Gross Value Added (GVA) was £25,601[55]. The 2015 headline estimates show that both total GVA and GVA per head at current basic prices have increased in all UK regions since 2014. In 2015, London had the highest GVA per head at £43,629 while Wales had the lowest at £18,002.

[53] Department for Education (2016) *Education and Training Statistics for the United Kingdom: 2016.* Available online at: https://www.gov.uk/government/statistics/education-and-training-statistics-for-the-uk-2016
[54] Crime Survey for England and Wales (2017) *Crime in England and Wales: year ending Mar 2017*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/crimeandjustice/bulletins/crimeinenglandandwales/yearendingmar2017
[55] Office for National Statistics (2016) *Regional Gross Value Added (income approach): 1997 to 2015.* Available online at: https://www.ons.gov.uk/economy/grossvalueaddedgva/bulletins/regionalgrossvalueaddedincomeapproach/december2016

In April 2016, median gross weekly earnings for full-time employees were £539, up 2.2% from £527 in 2015. The 2.2% growth seen this year was the joint highest growth in earnings seen since the economic downturn in 2008 (matching that seen in 2013)[56].

In the period May to July 2017, the UK had a total of 32,140,000 people in employment aged 16 and over, up 379,000 on the same period in the previous year[57]. The number of people employed in the private sector increased across the year by 365,000 to reach 26.70 million, while the number of people employed in the public sector increased by 14,000 to 5.44 million. In 2015 the job density of the UK was 0.83 (ratio of total jobs to working age population)[58]. In May to July 2017, the UK had an unemployment rate of 4.3% (people aged 16 and over), the lowest since March to May 1975.[57]

UK gross domestic product (GDP) is estimated to have increased by 0.3% in the second quarter of 2017, with GDP 1.7% higher compared with the same quarter a year ago. Production industries fell over the year by 0.4%, whilst the output of the service industries rose by 2.3% and agriculture by 1.7%[59].

Between 2009 and 2015, the largest job sector increase has been in the professional, scientific and technical industry group (24.47%), followed by business administration and support services (22.4%)[60]. The professional, scientific and technical industry sector is particularly strong in London and the south east. Since 2009, public administration has been the sector with the greatest decrease in employees (15.0%), and there have also been decreases in finance and insurance, construction and manufacturing.

Between 2014 and 2015, there were increases in all but three sectors, with professional, scientific and technical industries (5.6%) and transport and storage industries (5.4%) showing the largest increases. Finance and insurance, public administration and manufacturing showed decreases across the period.

In terms of the nuclear sector in general, the total workforce demand for 2017 is 87,560, with the peak demand forecast in 2021 for 100,619 workers.[61] For GDF specifically, the Radioactive Waste Management Ltd Geological Disposal Generic Socio-Economic Assessment[62] estimates up to 1,600 Full Time Equivalent (FTE) jobs will be supported at a national level as an annual average over the lifetime of a GDF. The economic development benefits of the GDF, at the national level are expected to range are expected to range from £7.8 billion to £37.9 billion (undiscounted).

[56] ONS (2016) *Annual Survey of Hours and Earnings: 2016 provisional results*. Available online at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/bulletins/annualsurveyofhoursandearnings/2016provisionalresults
[57] ONS (2017) *UK Labour Market: September 2017*. Available online at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/uklabourmarket/september2017
[58] NOMIS (2017) *Jobs density*. Available online at: https://www.nomisweb.co.uk/query/select/getdatasetbytheme.asp?opt=3&theme=&subgrp
[59] ONS (2017) *Gross domestic product, preliminary estimate: Apr to June 2017*. Available online at: https://www.ons.gov.uk/economy/grossdomesticproductgdp/bulletins/grossdomesticproductpreliminaryestimate/aprtojune2017
[60] ONS (2016) *UK business register and employment survey (BRES): 2014 revised and 2015 provisional.* Available online at: http://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/businessregisterandemploymentsurveybresprovisionalresults/2014revisedand2015provisional
[61] Nuclear Skills Strategy Group (2017) *Nuclear Workforce Assessment 2017*. Available online at: http://www.cogentskills.com/media/76523/nwa2017_public.pdf
[62] Radioactive Waste Management Ltd (2016) *Geological Disposal Generic Socio-Economic Assessment, December 2016*

England

Demographics

In mid-2016, England had a resident population of 55,268,100 (49.4% males and 50.6% females) and 63.1% of the population was of working age (aged 16 to 64)[63]. The total resident population accounts for 84% of the UK's population. The population of England increased by 481,800 (0.9%) across the previous year. England's population grew quicker than any other UK country during the year.

In the period May to July 2017, the working age population breakdown was as follows[64]:

- 79.1% were economically active, comprising:
  - 75.6% of working age population in employment[65]; and
  - 4.4% of working age population unemployed[66].
- 20.9% were economically inactive.

Education and Skills

The working age population in 2016 had the following qualifications:

- 37.9% had NVQ4 and above;
- 17.4% had NVQ3;
- 16.0% had NVQ2;
- 11.3% had NVQ1;
- 6.7% had other qualifications;
- 3.0% had trade apprenticeships; and
- 7.8% had no qualifications.

In January 2017, England had 24,218 schools, comprising:

- 402 nursery;
- 16,786 primary;
- 3,408 secondary;
- 2,297 independent;
- 1,037 special; and
- 351 pupil referral units[67].

[63] ONS (2017) *Population Estimates for UK, England and Wales, Scotland and Northern Ireland: mid-2016*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2016

[64] NOMIS (2017) *Labour Market Profile - England*. Available online at: https://www.nomisweb.co.uk/reports/lmp/gor/2092957699/report.aspx

[65] % are for those aged 16-64

[66] % is a proportion of economically active

[67] Department for Education (2017) *Schools, pupils and their characteristics: January 2017*. Available online at: https://www.gov.uk/government/statistics/schools-pupils-and-their-characteristics-january-2017

As of January 2017, there was total of 8.67 million pupils enrolled in schools in England. The total number of pupils has grown each year since 2009, and there are now over half a million more pupils in schools than at that point. Just over 3 million of the school pupils attend academies and free schools.

Economic Baseline

In 2015, England's per capita GVA was £26,159, which represents a 3.0% increase on 2014. England accounts for 86% of the UK's total GVA.[55]

In 2016, the median full-time gross hourly pay in England was £13.73 (male median being £14.35 and the female median being £12.89).

In May to July 2017, England had an unemployment rate of 4.4% (people aged 16 and over). This compares to same period in the previous year when the unemployment rate stood at 4.9%[64].

Since May to July 2016, there has been a 0.8 percentage point increase in employment in England, circa 370,000 people. In 2015 the job density of England was 0.84 (ratio of total jobs to working age population).

Deprivation

In England, 61% of local authority districts contain at least one of the most deprived neighbourhoods in England, according to the 2015 Index of Multiple Deprivation. Middlesbrough, Knowsley, Kingston upon Hull, Liverpool and Manchester are the local authorities with the highest proportions of neighbourhoods among the most deprived in England. On average, 37% of the population in the most deprived areas were income deprived. 83% of neighbourhoods that are the most deprived in 2015 were also the most deprived in 2010[68].

Scotland

Demographics

In mid-2016, Scotland had a resident population of 5,404,700 (48.6% male and 51.4% female) and 64.6% of the population was of working age (aged 16 to 64). The population grew by 31,700 since mid-2015 (increase of 0.6%), and accounts for 8.2% of the UK's population[69].

In the period May to July 2017, the working age population breakdown was as follows[70]:

- 78.8% were economically active, comprising:
  - 75.8% of working age population were in employment[71]; and
  - 3.8% of working age population were unemployed[72].
- 21.2% were economically inactive.

[68] DCLG (2015) *The English Indices of Deprivation 2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/465791/English_Indices_of_Deprivation_2015_-_Statistical_Release.pdf

[69] ONS (2017) *Population Estimates for UK, England and Wales, Scotland and Northern Ireland: mid-2016*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2016

[70] NOMIS (2017) *Labour Market Profile – Scotland*. Available online at: https://www.nomisweb.co.uk/reports/lmp/gor/2013265931/report.aspx

[71] % are for those aged 16-64.

[72] % is a proportion of economically active.

Education and Skills

The working age population in 2016 had the following qualifications:

- 43.7% had NVQ4 and above;
- 14.1% had NVQ3;
- 13.4% had NVQ2;
- 8.6% had NVQ1;
- 6.1% had other qualifications;
- 4.3% had trade apprenticeships; and
- 9.9% had no qualifications.

In April 2016, Scotland had 2,528 local authority schools[73], comprising:

- 2,034 primary;
- 359 secondary; and
- 135 special.

Crime

Differences in legal systems and police recording mean that the recorded crime figures for Scotland are not directly comparable with recorded crime figures for England and Wales. In Scotland, overall crimes recorded by police was 246,243 in 2015/16, an overall decrease of 4% compared to 2014/15 and the lowest level since 1974. Over the same time period, the number of non-sexual crimes of violence and sexual crimes increased by 7%, fire-raising and vandalism increased by 4%, while the number of crimes of dishonesty and other crimes decreased by 9% and 4% respectively[74].

Economic Baseline

In 2015, Scotland's per capita GVA was £23,685. This represents a 2.3% increase on 2014. Scotland accounts for 7.6% of the UK's total GVA.[55]

In 2016, the median full-time gross hourly pay in Scotland was £13.54 (male median being £13.95 and the female median being £12.99). This compares to £13.38 in 2015.

From May to July 2016 to the same period in 2017, there was a 1.8 percentage point increase in employment in Scotland, circa 45,000 people[75]. In 2015 the jobs density of Scotland was 0.79 (ratio of total jobs to working age population).

In May to July 2017 Scotland had an unemployment rate of 3.8% (people aged 16 and over). This compares to the same period in the previous year when the unemployment rate stood at 4.7%.

[73] Scottish Government (2016) *School Estates 2016 Supplementary Dataset*. Available online at: http://www.gov.scot/Topics/Statistics/Browse/School-Education/schoolestatestats/schestate2016
[74] Scottish Government (2016) *Recorded Crime in Scotland 2015-16*. Available online at: http://www.gov.scot/Resource/0050/00506122.pdf
[75] NOMIS (2017) *Labour Market Profile – Scotland*. Available online at: https://www.nomisweb.co.uk/reports/lmp/gor/2013265931/report.aspx

Deprivation

The Scottish Index of Multiple Deprivation (SIMD) 2016 shows that the pattern of multiple deprivation in Scotland has changed over time, with 11 council areas having a larger share of the 20% most deprived data zones in Scotland compared with SIMD 2012, while ten council areas had a smaller share. There are, however, deep-rooted areas of deprivation, most notably in Glasgow City, which have been consistently among the 5% most deprived in Scotland since SIMD 2004. Glasgow City also has the highest proportion of the most deprived data zones within its area, with almost half of its data zones being in the 20% most deprived. This is followed by Inverclyde, West Dunbartonshire, North Ayrshire and Dundee City[76].

Wales

Demographics

In mid-2016, the resident population of Wales was 3,113,200 (49.3% males and 50.7% females) and 61.7% of the population were of working age. The population grew by 14,100 (an increase of 0.5%) from mid-2015, and accounts for 5% of the UK's population.[77]

In the period May to July 2017, the working age population was broken down as follows[78]:

- 75.8% economically active, comprising:
  - 72.4% in employment[79]; and
  - 4.3% unemployed[80].
- 24.2% were economically inactive.

Education and Skills

The working age population in 2016 had the following qualifications:

- 35.1% NVQ4 and above;
- 17.6% NVQ3;
- 17.6% NVQ2;
- 10.9% NVQ1;
- 6.1% other qualifications;
- 3.2% trade apprenticeships; and
- 9.6% no qualifications.

In January 2017, Wales had 1,617 schools[81], comprising:

[76] Scottish Government (2016) The Scottish Index of Multiple Deprivation. Available online at: http://www.gov.scot/Topics/Statistics/SIMD
[77] ONS (2017) *Population Estimates for UK, England and Wales, Scotland and Northern Ireland: mid-2016*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland
[78] NOMIS (2017) *Labour Market Profile – Wales*. Available online at: https://www.nomisweb.co.uk/reports/lmp/gor/2013265930/report.aspx
[79] % are for those aged 16-64.
[80] % is a proportion of economically active.
[81] Welsh Government (2017) *Schools' Census Results*. Available online at: http://gov.wales/statistics-and-research/schools-census/?lang=en

- 11 nursery;
- 1,287 primary;
- 10 middle;
- 200 secondary;
- 39 special; and
- 70 independent.

Economic Baseline

In 2015, Wales' per capita GVA was £18,002, an increase of 3% compared to 2014. Wales accounts for 3.3% of the UK's total GVA.[55]

In 2016, the median full-time gross hourly pay in Wales was £12.66 (the male median being £13.04 and the female median being £12.01). This compares to £12.00 in 2015.

From May to July 2016 to the same period in 2017, there was a 0.7 percentage point reduction in employment in Wales, circa 22,000 people. In 2015 the job density of Wales was 0.74 (ratio of total jobs to working age population).

In the period May to July 2017, Wales had an unemployment rate of 4.3% (people aged 16 and over). This shows an increase from the previous year when it had an unemployment rate of 4.1%[82].

Deprivation

In the Welsh Index of Multiple Deprivation (WIMD) 2014 (revised in 2015), there were pockets of high relative deprivation in the South Wales valleys and large cities, and in some North Wales coastal and border towns. The overall picture is similar to that of WIMD 2011, with six of the ten most deprived areas from WIMD 2011 remaining in the ten most deprived areas in WIMD 2014. The local authority with the highest proportion of areas in the most deprived 10 per cent in Wales in WIMD 2014 was Blaenau Gwent (23.4%), while Monmouthshire had no areas in the most deprived 10 per cent.[83]

Summary of Existing Problems Relevant to the Geological Disposal NPS

The following existing problems for the population, economics and skills topic have been identified:

- The growing population within the UK will increase population densities and, in-turn, the likelihood of communities being within close proximity to a GDF or transport of High Level Waste (HLW) and Intermediate Level Waste (ILW). This could increase the likelihood of operations having, or being perceived to have, a negative impact on communities.

[82] NOMIS (2017) *Labour Market Profile – Wales*. Available online at: https://www.nomisweb.co.uk/reports/lmp/gor/2013265930/report.aspx
[83] Welsh Government (2015) *Welsh Index of Multiple Deprivation*. Available online at: http://gov.wales/statistics-and-research/welsh-index-multiple-deprivation/?lang=en

- There is a broad level of consistency with regard to the qualifications of the working age population in England, Scotland and Wales, with approximately 38% having a NVQ4 or equivalent qualification and above. Scotland has the greatest proportion of the population with this level of qualification (43.7%), while Wales has the lowest (35.1%). In addition, 8.3% have no qualifications and this should be addressed.
- The respective indicators and areas of multiple deprivation in England, Scotland and Wales are similar in that there continues to be deprivation in specific areas year after year. That said, there is also some broader variation to the areas of deprivation across the rest of the country.

Likely Evolution of the Baseline

UK

Demographics

The current UK population is generally increasing and is projected to reach 74.3 million by 2039, a rise of 9.7 million people[84]. Assumed net migration accounts for 51% of the projected increase, with natural increase (more births than deaths) accounting for the remaining 49% of growth.

The age structure of the UK population is moving towards an ageing population, with the average (median) age rising from 40.0 years in 2014 to 42.9 by mid-2039. The number of people of State Pension Age and over is projected to increase by 32.7% to 16.5 million by mid-2039, despite increases to State Pension Age. By mid-2039 more than 1 in 12 of the population is projected to be aged 80 or over.

Those aged under 14 is projected to increase from 11.4 million in 2014 to 12.3 million in 2024 and stay at approximately this level for the next 15 years. There are no formal targets for population growth in the UK.

Economics

There are current uncertainties over market conditions, and the outlook for growth in the short to medium term has weakened following the UK's vote to leave the European Union. With a fall in the exchange rate and likely rises in inflation, the Bank of England highlights that whilst financial conditions are currently stable, there are a number of possible exit scenarios from the European Union that could test the resilience of the financial system[85]. The Bank of England also notes that if the economy follows a path broadly consistent with the August 2017 central projection, then monetary policy could need to be tightened by a greater extent over the forecast period than is currently expected[86].

[84] ONS (2015) *National Population Projections: 2014-based Statistical Bulletin*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2015-10-29

[85] Bank of England (2017) *Financial Stability Report: Executive summary July 2017*. Available online at: http://www.bankofengland.co.uk/publications/Documents/fsr/2017/fsrjun17sum.pdf

[86] Bank of England (2017) *Inflation Report August 2017*. Available online at: http://www.bankofengland.co.uk/publications/Documents/inflationreport/2017/aug.pdf

England

Demographics

Between 2014 and 2039, the population of England is projected to increase from 54.3 million to 63.3 million, an increase of 16.3%[84].

Economics

England's total GVA growth in 2015 was up 3% from 2014. GVA has risen year on year since 2009[55], so it could be expected that it will continue to increase in the future, although the rate may slow given the UK outlook.

Scotland

Demographic

Between 2014 and 2039, the population of Scotland is projected to increase from 5.3 to 5.7 million, an increase of 6.6%[84].

Scotland has a population target of matching the average European (EU15) population growth over the period from 2007 to 2017. In 2014/15, population growth for was higher than that of the EU15 countries. In 2016, the average annual population growth rates since 2007 for Scotland and the EU15 were 0.50% and 0.41%, respectively.[87]

Economics

Scottish GDP grew 0.8% during the first quarter of 2017. The services sector grew by 0.3% and the Production sector by 3.1%. The construction sector contracted by 0.7%. On an annual basis, comparing the latest quarter to the same period in the previous year, Scottish GDP grew by 0.7%[88].

Wales

Demographic

The population of Wales is projected to increase to 3.3 million by 2039 (a 6.1% increase compared to 3.1 million in 2014)[84].

Economics

When comparing the year ending March 2016 to the year ending March 2017, the Index of Production for Wales increased by 4.1%. This increase was largely accounted for by an increase in output in the 'Other Manufacturing and Repair' and 'Rubber and Plastics and other Non-metallic Minerals' sectors. The Index of Construction for Wales increased by 6.6% across the same period[89].

[87] Scottish Government (2017) *Purpose Target: Population*. Available online at: http://www.gov.scot/About/Performance/scotPerforms/purposetargets/population
[88] Scottish Government (2017) *Scotland's gross domestic product: 1st quarter 2017*. Available online at: http://www.gov.scot/Topics/Statistics/Browse/Economy/PubGDP/GDP2017Q1
[89] Welsh Government (2017) *Index of Production and Index of Construction for Wales: 2017 Quarter 1*. Available online at: http://gov.wales/docs/statistics/2017/170727-index-production-construction-quarter-1-2017-en.pdf

Welsh total GVA rose by 3.0% from 2014 to 2015, and has risen year on year since 2009[90]. It could be expected that it will continue to increase in the future, although the rate may slow given the weakened growth expectations for the UK.

Assessing Significance

The objectives and guide questions related to population which have been identified for use in the appraisal of the effects of Geological Disposal Infrastructure NPS proposals and alternatives are set out in **Table 2.2**, together with reasons for their selection.

Table 2.2 Approach to Assessing the Effects of the Geological Disposal infrastructure NPS Proposals on Population, Economics and Skills

Objective/Guide Question	Reasoning
Objective: To promote a strong, diverse and stable economy with opportunities for all; improve education and skills, minimise disturbance to local communities and maximise positive social impacts.	The SEA Directive (2001/42/EC) requires that the likely significant effects on population should be taken into account in the Environmental Report, which for the purposes of the AoS is incorporated within the AoS Report.
Will the Geological Disposal Infrastructure NPS affect the social infrastructure and amenities available to local communities?	Any development of radioactive waste geological disposal facilities (in common with all major projects) has the potential to impact on the local social infrastructure and amenities which could affect the quality of life of individuals in local communities.
Will the Geological Disposal Infrastructure NPS affect local population demographics and/ or levels of deprivation in surrounding areas?	The Geological Disposal NPS may result in change to population demographics (for example, through in migration of workers skilled to work in the industry). Changes to local population demographics and employment have the potential to impact on the local economy and demand for community facilities such as healthcare, education and recreation. Changes to these factors may alter the levels of deprivation in an area.
Will the Geological Disposal Infrastructure NPS affect opportunities for investment in education and skills development?	Investment in education and skills development are vital for economic growth.
Will the Geological Disposal Infrastructure NPS affect the number or types of jobs available in local economies?	Affecting the number or type of jobs will have influences on the local economy and productivity. The majority of jobs for GDF construction will be skilled (e.g. geologists, geophysicists, engineers and drilling experts) and this may have an influence on the types of jobs within the local area. The Geological Disposal Generic Socio-economic Assessment[91] identifies that a GDF could

[90] StatsWales (2016) *Gross Value Added by component, Welsh NUTS2 areas and year.* Available online at: https://statswales.gov.wales/Catalogue/Business-Economy-and-Labour-Market/Regional-Accounts/Gross-Value-Added-GDP/gva-by-component-welshnuts2areas-year

[91] Radioactive Waste Management Ltd (December 2016) *Geological Disposal Generic Socio-Economic Assessment*

Objective/Guide Question	Reasoning
	generate 500-600 direct jobs in an average year throughout the lifetime of the facility, while a further 400-1,000 jobs could be created through indirect and induced employment effects.
Will the Geological Disposal Infrastructure NPS affect how diverse and robust local economies are?	A diverse and robust economy is important to ensure economic growth.

Table 2.3 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the population objective.

Table 2.3 Illustrative Guidance for the Assessment of Significance for Population, Economics and Skills

Effect	Description	Illustrative Guidance
++	Significant Positive	• Option would incorporate the provision of social infrastructure and amenities; • Option would provide educational services/facilities and offer long-term opportunities for skills development including, for example, apprenticeship schemes; • Option would generate in the order of 640 or more direct full time equivalent (FTE) employment opportunities per annum[1], a large proportion of which will benefit the local community; • Option would generate significant investment in local supply chains fostering economic growth, generating indirect employment opportunities and enhancing the robustness of the local economy (e.g. through the procurement of local contractors to undertake construction activities); • Option would significantly enhance the attractiveness of an area to existing and prospective residents and businesses (e.g. through the generation of employment opportunities).
+	Positive	• Option would stimulate some limited investment in existing services and amenities (e.g. associated with any increase in the work place population); • Option would provide some educational opportunities and skills development including, for example, apprenticeship schemes; • Option would generate some direct full time equivalent (FTE) employment opportunities per annum (below 640) which may benefit the local community; • Option would generate limited investment in local supply chains (e.g. through the procurement of local contractors to undertake

Effect	Description	Illustrative Guidance
		construction activities); • Option would enhance the attractiveness of an area to existing and prospective residents and businesses (e.g. through the generation of employment opportunities and provision of infrastructure).
0	Neutral	• Option would not affect social infrastructure and amenities available to local communities; • Option would not affect the provision of educational services/facilities or offer opportunities for skills development; • Option would not affect any local employment opportunities/increase local unemployment rates; • Option would have no effect on wider economic benefits/undermine the growth and diversity of the local economy; • Option would not affect the attractiveness of the area to existing and prospective residents and businesses.
-	Negative	• Option would cause some disruption to existing services and amenities available to local communities which is likely to be felt in the short term; • Option would lead to a loss of some direct FTE jobs (below 640 per annum) (e.g. due to the cessation of some activities or rationalisation of activities on sites); • Option would reduce the resilience and diversity of the local economy (e.g. through loss of local supply chain opportunities); • Option would reduce local investment in an area and affect growth of local economy; • Option would undermine the attractiveness of an area to existing and prospective residents and businesses (e.g. due to impacts arising from construction activities or concerns regarding operational impacts); • Option would undermine the quality of life of the local population (e.g. due to noise and vibration associated with HGV movements during construction or operation) such that some complaints could be expected.
--	Significant Negative	• Option would result in the loss of existing services and amenities available to local communities (e.g. where development is proposed on a site in community use); • Option would lead to a significant loss of direct FTE jobs (a minimum of 640 per annum) (e.g. due to the closure of local employment sites); • Option would significantly reduce the resilience and diversity of the local economy (e.g. through significant loss of local contracts and supply chain opportunities); • Option would lead to a significant reduction in investment in an area that will affect the growth of local economy; • Option would significantly undermine the attractiveness of an area to existing and prospective residents and businesses (e.g. due to impacts arising from construction activities or concerns regarding the operational impacts); • Option would seriously undermine the quality of life of the local population (e.g. due to noise and vibration associated with HGV

Effect	Description	Illustrative Guidance
		movements during construction or operation of facilities) such that the project and local authority would be likely to experience a considerable number of complaints.
?	Uncertain	• From the level of information available the effect that the option would have on this objective is uncertain.

[1] The proposed threshold of significance represents around 1% of the existing 64,000 jobs supported by the nuclear industry in the UK (https://www.niauk.org/resources/facts-information-booklet/).

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 2.4 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria[92]' and 'No NPS' on the population, economics and skills objective. The appraisal considers in-turn the three sub-sections used for each topic within Chapter 5 of the draft NPS: Applicant's Assessment; Decision Making and Mitigation. The performance of the draft NPS and the two reasonable alternatives are scored accordingly, with a commentary provided in the Appraisal column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15 - 20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement. These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-term (less than 20 years), MT – medium-term (between 20 and 170 years) and LT – long-term (>170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

[92] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

Table 2.4 Appraisal of the Draft NPS and Reasonable Alternatives: Population, Economics and Skills

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	**+**	**+/?**	**+/?**	**Draft NPS:** The text in the draft NPS under the heading of the Applicant's Assessment states that (our emphasis): 5.7.3 *"Applicants should demonstrate that with any geological disposal infrastructure development they have taken steps to ensure that the **entire demographic, including all equality groups in the area is considered**. The applicant should consider how the impacts of geological disposal infrastructure, **such as socio-economics, visual impacts and traffic and transport may affect the social infrastructure and amenities available to local communities.**"* 5.7.5 *"Applicants **should assess any likely, significant positive and negative socio-economic impacts.** The assessment should look at the potential impacts over the **operational lifespan of the proposed development, and the potential impacts of its closure so far as is reasonable**."* *5.7.6: "The assessment should cover any socio-economic impacts appropriate to the proposed development. Examples include:* • *the **creation of jobs and training opportunities;*** • *the provision of **educational and visitor facilities;*** • *the **impact of the proposed new facility on equalities groups and effects on tourism and the impact on local services;*** • *the need for **accommodation for workers**.* 5.7.7 *"The changing **influx of workers during construction, operation (construction will be continue through most of the operation phase of the geological disposal facility) and eventual closure**/sealing phases of the geological disposal infrastructure may alter the **demand for services and facilities** in the areas surrounding the proposed development. This could change the **local population dynamics** and could alter the **demand for services and facilities** in the settlements nearest to the construction work (including community facilities and physical infrastructure such as **energy, water, transport and waste**). There could also be effects on **social cohesion** depending on how populations and service provision change as a result of the development."* 5.7.8 *"Cumulative effects on communities should be assessed. For example, if development consent, or consent under other regimes, were to be granted for a number of infrastructure projects within a region and these were developed in a similar timeframe; there could be some short-term negative effects. For example a **potential shortage of construction workers** to meet the needs of other industries and major projects within the region."* *5.7.9 "As many of the on-site functions of a geological disposal facility are relatively labour-intensive, new job and up-skilling opportunities are likely to arise. Applications should assess related issues such as the **availability of a suitable workforce and the potential wider and longer term benefits to the economy**."* 5.7.10 "*In considering alternative site locations, the developer should take account of potential impacts of alternative project options in respect of any adverse effects on different groups of the population. Potential impacts on pollution and noise in respect of any adverse effects on equality groups should also be taken into account, **for example by carrying out an equalities impact assessment**."* 5.7.11 "*Socio-economic impacts may be linked to other impacts, for example the visual impact or an individual's perception*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				*of a development. It may also have an impact on **local businesses or property value**. Where such impacts are relevant to the development, an applicant should include them in their assessments*." Section 5.9.5 of the draft NPS references the need to consider the indirect health impacts that arise as a result of development. For example, if it in some way affects the use of open space for recreation and physical activity. It is apparent from the above that the draft NPS identifies a broad range of factors to be considered as part of any planning application for a GDF. Overall it is judged to have a positive effect against the AoS Objective. *<u>Recommendations for Improvement</u>* The draft NPS provides a comprehensive range of factors to be considered by the developer when undertaking the assessment, which is considered appropriate and relevant. The text on employment could be expanded to explicitly require the assessment of the direct, indirect and induced employment associated with different phases of development, allowing for any negative effects on other parts of the economy, e.g. tourism or any job losses associated with closure of any interim surface storage facilities (for higher activity waste that would be taken to a GDF). Given the nature of the project and in particular its timescale it could be appropriate for employment to be estimated on an annual basis over the course of the project (or at least the distinct phases of the project). The generic socio-economic assessment prepared by the Radioactive Waste Management Limited demonstrates the principle of estimating employment on an annual basis.[93] Overall it is considered that the draft NPS is likely to have a positive contribution to this objective by setting out a range of factors to be considered in preparing an application.
				Draft NPS including Exclusionary Criteria: Given the anticipated scope of the exclusionary criteria, which could include landscape, natural and cultural heritage and the fact that tourism/leisure can be an important element of the local economy in such areas, there could be indirect socio-economic benefits associated with excluding them, ensuring that any adverse effects on those sectors of the economy represented in the area would be avoided. However, the result would be to displace the effect elsewhere, possibly to an area that is not designated but even more reliant on tourism and therefore more sensitive to change. Further, the exclusion of areas could reduce the scope of community engagement and unnecessarily exclude communities in these areas from the potential socio-economic benefits of hosting a GDF. Overall this alternative has been assessed as likely to have a positive effect on the population, economics and skills objective although a degree of uncertainty persists.
				No NPS: Applications would be subject to the provision of national planning policy and EIA which would require consideration of the effects on population and the community. In consequence, even without the NPS, it would therefore still be considered to have a positive effect in relation to population, economics and skills. However, the absence of a clear statement of the full range of considerations to be taken into account (as proposed in the NPS) risks inconsistency in interpretation, particularly at a project level which could have more uncertain outcomes (and at least the possibility that all

[93] Radioactive Waste Management Ltd (December 2016) *Geological Disposal Generic Socio-Economic Assessment*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				beneficial effects are not enhanced and all adverse effects not avoided, minimised or mitigated). Overall, this alternative has been assessed as likely to have a positive effect on the population, economics and skills objective although a degree of uncertainty persists.
Decision making	**+**	**+**	**+/?**	**Draft NPS:** 5.7.12 states: *"Prior to making a development consent application, the applicant should have undertaken a public consultation programme to understand the needs and concerns of local communities and acted upon, or have plans to act upon, the outcome of this where appropriate."* 5.7.13 states: *"The Secretary of State should have regard to the potential socio-economic impacts of new geological disposal infrastructure identified by the applicant. It should be reasonable for the Secretary of State to conclude that speculative assertions of socio-economic impacts, not supported by evidence, should be given little weight (particularly in view of the need for geological disposal infrastructure as set out in this NPS)."* 5.7.14 states: *"The Secretary of State should consider any relevant positive provisions the applicant has made or is proposing to make, to mitigate impacts (for example through planning obligations) and community investment that may arise as well as any options for phasing development in relation to the socio-economic impacts."* Overall it is considered that the draft NPS is likely to have a positive contribution to this objective by setting out a range of factors to be considered in determining an application.
				Draft NPS including Exclusionary Criteria: Given the anticipated scope of the exclusionary criteria and all other things being equal there is no anticipated difference between the draft NPS with or without the exclusionary criteria in relation to this part of the Strategy.
				No NPS: Under this alternative socio-economic considerations would be considered in accordance with amended EIA Regulations and so it remains likely that this alternative would have positive effects. However, the opportunity for the NPS to provide clarity and further guidance, with Section 5 outlining the broad scope of any assessment in relation to socio-economic considerations would be lost causing some uncertainty within the appraisal of effects against this objective.
Mitigation	**+/?**	**+/?**	**+/?**	**Draft NPS:** 5.7.15 states (our emphasis): "*The Secretary of State should consider whether the mitigation measures put forward by the applicant are acceptable in order to mitigate any adverse socio-economic impacts of the development. For example, **high quality design and/or screening (e.g. by natural features) can improve the visual and environmental experience for visitors and the local community** alike."* 5.7.16 states: *"The Secretary of State should only grant development consent where the measures put forward by the applicant to mitigate any adverse equalities impacts are acceptable."* Overall it is considered that the draft NPS makes a positive contribution, albeit with some uncertainty, to this objective by identifying mitigation as a material consideration. The mitigation could be revised to be broader (reflecting the issues highlighted earlier in the NPS), more specific and clearly

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				reflect the potential effects associated with the key project stages of site investigation, construction, operation and closure. It could also go beyond mitigation and consider opportunities for enhancement as summarised below. A generic socio-economic assessment for a GDF identified the following potential effects in terms of employment generation and investment[94]: • Based on estimated manpower requirements, the employment analysis indicates that up to 1,600 Full Time Equivalent (FTE) jobs will be supported at a national level as an annual average over the lifetime of a GDF. Of these, 500 – 600 will be direct FTE jobs, i.e. people directly employed in the planning, construction, operation and eventual closure of the facility. The remainder will be additional jobs supported in the supply chain (indirect jobs) or supported by increased spending in the wider economy (induced jobs); • These estimates are not net of any job losses associated with the surface storage of waste that would go to a GDF but the scale of losses is not likely to be significant; • In terms of economic development, at a district level, the additional expenditure in the economy is expected to range from around £3.4 billion to £8.3 billion in undiscounted spend over the lifetime of the project. At a regional level, once the district effects are subtracted, the economic development benefits are expected to range from £2.4 billion to £5.4 billion (undiscounted) over the same period. At the national level, the economic development benefits are expected to range from £7.8 billion to £37.9 billion (undiscounted); • Potential negative effects could include a modest reduction in property values within a few kilometres of a proposed site. A positive impact on property values in the longer term is considered likely once a facility is constructed and operating, driven by skilled workers and an increased demand for local housing. • Depending on its location, leisure tourism effects could range from a loss of around £398 million for a rural coastal area and a loss of £1,681m in an urban coastal area (undiscounted over the lifetime of the project). The study includes suggested measures for mitigating such effects. Whilst these figures are based on a generic assessment they are useful in terms of giving a sense of the scale of the level of employment and expenditure associated with a GDF and setting the context for the assessment. The NPS could highlight the opportunity to optimise the extent to which such benefits are captured in the local economy, e.g. through the promotion of apprenticeships and other initiatives associated with the construction and operational phases and the need for measures to mitigate potential effects on property values and leisure related tourism (as outlined below). *Site Investigation* During the siting process the developer would work with potential host communities, helping them to identify and articulate their aspirations for sustainable community development. This process of engagement will help to ensure that potential host communities make the most of the socio-economic opportunities provided through the project and through additional Government investment. The siting process has been estimated to support an average of around 440 direct jobs per year[95].

[94] Radioactive Waste Management Ltd (December 2016) *Geological Disposal Generic Socio-Economic Assessment*
[95] Radioactive Waste Management Ltd (December 2016) *Geological Disposal Generic Socio-Economic Assessment.* Appendix A, Table A1

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Although the overall socio-economic effects are expected to be positive, there is the potential for some adverse effects, notably on property prices, leisure tourism and inward investment in some economic sectors. Such effects are associated with changed perceptions of an area as a place to live, work or invest and could be manifest during the siting process. Mitigation and enhancement during the siting process could include: • Developing a programme for community engagement, this could incorporate a public outreach strategy that addresses safety concerns from the local and broader population; • Providing a Community Liaison Group to liaise with community leaders about opportunities for community development; • Developing and implementing an employee code of conduct including guidance on behaviour offsite and outside of working times. • Partnering with a local training provider and national skills body to establish a construction apprenticeship learning hub; • Introducing a Property Value Protection Plan to compensate property owners for any losses associated with a decrease in property values, rental income or associated mortgages attributable to the GDF project; • Providing measures to support local procurement opportunities (Local Enterprise Growth initiative), e.g. local business engagement strategy; network to link contractors and major suppliers with smaller companies etc. • Developing and implementing an Accommodation Strategy for new workers *Construction* Direct employment is expected to peak during this phase – at around 840 jobs per annum. There will also be beneficial multiplier effects as workers migrate into the area and increase demand for local services and facilities. Measures outline above in relation to the siting phase are also relevant to this phase, e.g. in relation to apprenticeships. Integration of new residents within the host community will also be an important consideration, both in order to avoid transience (i.e. workers who are only 'passing through' the community), which could take jobs away from existing residents, and to promote community cohesion. Suggested mitigation includes: • Ensuring that the Accommodation Strategy is flexible to accommodate growth in employment. • Measures to encourage local procurement. *Operation & Closure* During the operational phase socio-economic effects are likely to be similar to those during the initial construction phase, indeed some construction work would be on-going during the operational phase. Direct employment levels will drop from the peak construction level, but several hundred new, long-term, skilled jobs will continue, together with the associated economic benefits. As time goes by "new" residents are likely to become fully integrated into the local community and significant effects on community cohesion are unlikely. Similarly, additional effects on property values, leisure tourism and inward investment are unlikely. Adverse effects on the local economy associated with loss of jobs and a post-closure economic downturn could lead to adverse socio-economic impacts. It is likely that the closure and decommissioning of a GDF will be subject to detailed

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				assessments at the time. The draft NPS identifies the need for an outline assessment of the effects of closure but more could be done at this stage to consider appropriate after-uses for the site. The NPS could also identify the need to develop and implement an economic transition scheme for transition between project phases and for post closure of the site. Note that there are suggestions for mitigation/enhancement made under the topics of health and land use that are also relevant to this topic. *Recommendations for Improvement* Mitigation could be broadened out to include opportunities for enhancement at the local level. Mitigation could be structured around the key project stages.
				Draft NPS including Exclusionary Criteria: Given the anticipated scope of the exclusionary criteria and all other things being equal there is no anticipated difference between the draft NPS with and without exclusionary criteria in relation to this part of the Strategy.
				No NPS: Under this alternative socio-economic considerations would be considered in accordance with amended EIA Regulations and the broad range of positive effects associated with the GDF would occur. However, the opportunity for the NPS to provide clarity and further guidance, with Section 5 outlining the broad scope of any assessment in relation to socio-economic considerations would be lost causing some uncertainty within the appraisal of effects against this objective.
Other Sections of the Draft NPS Relevant to Population, Economy and Skills	**1. Introduction** 1.1.3 There is an opportunity for the consideration of effects on population, economics and skills in a specific locality through the preparation of a local impact report submitted by a local authority in accordance with the Planning Act 2008. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on relevant issues, helping to ensure that consideration is given to likely effects in a particular locality. 1.1.4 Consideration of socio-economic interests is reflected in the need to apply the NPS in the context of section 104 of the Planning Act. This should help ensure that related effects, (both positive and negative), in so far as they are relevant to planning, are balanced. The net result of this balancing exercise could be uncertain, however. **1.4 Consideration of deep boreholes investigations** – the role and content of an Environmental Statement, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of socio-economic interests, including the potential for cumulative effects – by setting out these principles, the NPS has a positive impact in relation to the consideration of socio-economic and other issues as part of the consenting process. **1.5 Consideration of geological disposal facilities** - the spatial disposition of facilities and the timescale of development could affect socio-economic interests although the requirements for limiting cumulative negative impacts within safety and reasonable financial constraints should help to minimise impacts. **2. Government Policy on Management of Higher Activity Radioactive Waste** 2.2.6 The preference for disposal through a single site will help to confine effects to a specific area thus limiting the likely extent of any effects on this topic, although these could still be significant in respect of that particular site. 2.4.3 The strategy for implementation provides for the opportunity to consider this topic as the process proceeds iteratively, including discussions with communities of interest. This could include opportunities to optimise positive outcomes in relation to this topic, e.g. in terms of employment, procurement and training. **3. The Need for Geological Disposal Infrastructure**			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	The identification of technical and ethical considerations which prompt the need to provide for a GDF will benefit health interests through the adoption of a responsible approach to waste disposal. As such, this lessens the risks to society, including those associated with impacts on population and the economy over a wide area through leakage of radioactive materials (for various reasons). **4. Assessment Principles** **4.1 General principles of assessment** - The provisions of the Planning Act 2008 and the policies and protections set out in the draft NPS provide for a balanced consideration of needs. The requirement for the identification of adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for the protection and enhancement of socio-economic related interests. **4.2 Environmental Impact Assessment** – the consideration of proposals within the EIA Regulations and the preparation of an Environmental Statement (where required) agreed by statutory agencies and specifying mitigation and enhancement measures will ensure that socio-economic interests are fully considered, as will the consideration of cumulative effects and interrelationships between effects. **4.3 Habitats Regulations Assessment** – no direct relationship identified. **4.4 Alternatives** – the requirement that reasonable alternatives will need to be considered as part of scheme design and project planning should ensure that socio-economic related issues are taken into account, both in terms of protection and opportunities for mitigation and enhancement. **4.5 Criteria for 'good design' for geological disposal infrastructure** – attention to good design principles and implementation will be of benefit to socio-economic interests through the consideration of how a proposed facility interacts with its context. This could include consideration of connectivity and access to facilities etc. Good design also provides the opportunity to create a facility and features that people will want to visit, e.g. landscape features and public art. **4.6 Climate Change Adaptation** – Ensuring that any development is appropriately adapted to future climate change will help avoid socio-economic impacts associated with closure or impacts on operations. **4.7 Pollution Control and other Environmental Regulatory Regimes** – the protection provided by other legislative provisions highlighted in the draft NPS will be important in helping to address any concerns about the presence of such a facility, which might otherwise have an adverse impact on a local area, e.g. through loss of income and investment. **4.8 Common Law Nuisance and Statutory Nuisance** – 4.8.2 of the draft NPS notes that: "*It is very important that, during examination of a nationally significant infrastructure project, the Examining Authority considers possible sources of nuisance under Section 79(1) of the Environmental Protection Act 1990, and how they may be mitigated or limited. This will enable the Examining Authority to recommend appropriate requirements that the Secretary of State may wish to include in any subsequent order granting development consent".* Provisions in relation to statutory nuisance will help ensure that significant effects in relation to health and other socio-economic considerations are avoided. **4.9 Safety** – The draft NPS highlights the role of other safety regimes and the need for the Secretary of State to have regard to health and safety legislation applying to the construction and operation of geological disposal infrastructure. This primarily relates to the health topic considered elsewhere in this AoS but there are also broader socio-economic benefits to be gained from the health and safety regimes referred to. The draft NPS acknowledges the need to consider the potential for broader impacts on the population, e.g. associated with access to services. **4.10 Health** – This section highlights the need for the Environmental Statement to consider effects on human beings and include measures to avoid, reduce or compensate such impacts as appropriate. The potential for impacts to simultaneously affect people and the need to take account of this is highlighted. **4.11 Security Considerations** – This section of the draft NPS outlines established security considerations and responsible Government departments, which would apply to a GDF. These considerations would apply irrespective of whether or not the draft NPS was in place so no additional environmental effects are anticipated			
Summary	**+**	**+/?**	**+/?**	**Draft NPS:** The draft NPS highlights the broad range of issues that will need to be considered under the topic of population,

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Appraisal of Likely Significant Effects				economics and skills. It could be more explicit in terms of what should be assessed and provide more guidance on areas for mitigation and enhancement. There are potential synergies between this topic, health and land-use. Potential impacts on social infrastructure and amenities available to local communities (both positive and negative) could occur throughout the key stages in the project and this is recognised in the applicant's assessment set out in the draft NPS and very broadly in the mitigation section. There is potential for the project to affect local population demographics and levels of deprivation although the associated scale of growth is small relative to other nationally significant infrastructure projects. This is recognised in the applicant's assessment set out in the draft NPS and very broadly in the mitigation section. There is an opportunity to ensure that local economic benefits, including the take up of jobs are optimised, which the draft NPS broadly recognises. There is an opportunity for investment in local skills and education, which the draft NPS recognises. There is potential for the number and types of jobs available in a local area to be affected. There is potential for a negative impact on tourism in the short term, together with a potential loss of employment associated with the surface storage of waste but these are likely to be offset by direct, indirect and induced employment associated with the facility. There is also the potential that negative effects could include a slight reduction in property values very close to a GDF. Such effects are associated with changed perceptions of an area as a place to live, work or invest and could be manifest during the siting process.
				Draft NPS including Exclusionary Criteria: Given the anticipated scope of the exclusionary criteria, which could include landscape, natural and cultural heritage and the fact that tourism/leisure can be an important element of the local economy in such areas, there could be indirect socio-economic benefits associated with excluding them from areas considered suitable for a GDF and related infrastructure. This would ensure that any adverse effects on those sectors of the economy represented in the area would be avoided. However the result would be to displace the effect elsewhere, possibly to an area that is not designated but even more reliant on tourism and therefore more sensitive to change. Further, the exclusion of areas could reduce the scope of community engagement and unnecessarily exclude communities in these areas from the potential socio-economic benefits of hosting a GDF.
				No NPS: Despite the absence of a guiding framework to consider socio-economic issues, applications would be subject to the provision of national planning policy and EIA Regulations and the resulting overall effects are likely to be positive. However, the absence of clear expectations as to design (including mitigation and enhancement) and planning obligations relating the specific case of a GDF could lead to uncertainty and inconsistency in their application and missed opportunities for social and economic benefit. The precise range of mitigation applied as part of any scheme development would potentially be less certain and with greater inconsistency than under a NPS.
Summary of Recommended Mitigation and Enhancement	As currently drafted, the effects from the draft NPS and the reasonable alternatives to it are broadly similar. Including more guidance on mitigation and enhancement in Section 5 would differentiate it from the no NPS alternative. The overall assessment recognises that there could be a distinction to be made between the NPS with and without exclusionary criteria but it is difficult to be certain. The following suggestions are made: • Section 5 could explicitly state that direct, indirect and induced employment associated with both the construction and operation of the facility should be assessed. • Section 5 could discuss the need for the after-use of the site to be considered and the arrangements that could be put in place to secure this. There is a parallel with			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	former mineral workings that did not have an agreed scheme for restoration in place. Legacy / arrangements for long-term management could be discussed as part of the applicant's assessment. • Clarify the extent to which a potential impact on local property prices, together with any proposed mitigation/avoidance measures, is a material consideration and the information required to address this, if relevant. • Add additional text in relation to mitigation/enhancement as outlined above.			

3. Human Health

Introduction

This section presents the overview of plans, programmes and baseline information for the appraisal of sustainability of the National Policy Statement for Geological Disposal Infrastructure and reasonable alternatives in respect of human health.

There are links between the human health topic and other topics in the Appraisal of Sustainability (AoS), including population, economics and skills, air quality, noise and water quality.

Review of Plans and Programmes

The review of plans and programmes identifies the broad range of plans that seek to promote health and healthy lifestyles. Between them, they identify various factors that contribute to health including the availability of green space and the influence of poor air quality and noise. There is a recognised need to protect the health of children from environmental hazards, in addition to specific requirements for the protection of the wider population from exposure to ionising radiation.

International/European

The World Health Organization (WHO) states in the ***Ottawa Charter for Health Promotion (1986)*** that *"health promotion goes beyond health care. It puts health on the agenda of policy makers in all sectors and at all levels";* consequently, healthy public policy has been a main goal of health development in many countries. The ***Canadian Lalonde Report (1974)*** identified four health fields independently responsible for individual health: environment, human biology, lifestyle and health care organisation.

Health 2020 (2012) is the WHO's health policy framework for Europe. It aims to support action across government and society to: significantly improve the health and well-being of populations, reduce health inequalities, strengthen public health and ensure people-centred health systems that are universal, equitable, sustainable and of high quality.

The WHO ***Children's Environment and Health Action Plan for Europe (CEHAPE) (2004)*** was launched at the Fourth Ministerial Conference on Environment and Health in June 2004 and signed by all 53 Member States of the WHO European Region, including the UK. The aim of the CEHAPE is to protect the health of children and young people from environmental hazards. The ***Fifth Ministerial Conference on Environment and Health 2010, Parma,*** resulted in strengthened commitments to act on children's health and protection from the effects of climate change.

In 2007 the European Commission adopted an overarching Health Strategy ***Together for Health - A Strategic Approach for the EU 2008-2013***. The Health Strategy has three strategic objectives: fostering good health in an ageing Europe, protecting citizens from health threats, and supporting dynamic health systems and new technologies. As part of the EU Health Strategy there is a focus on health as a precondition for economic prosperity and the need for smarter investments in health. The Strategy also supports the principle of 'health in all policies', which involves strengthening the integration of health concerns into all policies at

Community, Member State and regional levels. An evaluation by the European Commission in 2011 determined that the strategy will remain valid for the next decade and will support the broader Europe 2020 strategy. Europe 2020 aims to turn the EU into a smart, sustainable and inclusive economy promoting growth for all – one prerequisite of which is a population in good health.

The ***Third EU Health Programme 2014-2020*** is in place to implement the Health Strategy, with objectives to: promote health, prevent diseases, and foster supportive environments for healthy lifestyles; protect citizens from serious cross-border health threats; contribute to innovative, efficient and sustainable health systems; and facilitate access to better and safer healthcare for Union citizens.

The Commission published ***Towards Social Investment for Growth and Cohesion 2014-2020 (2013)***, supported by the Commission staff working document ***Investing in Health (2013)***, to show how investing in health contributes towards the Europe 2020 objective of smart, sustainable and inclusive growth.

The ***SEA Directive (2001/42/EC)*** adopted in 2001 specifically requires the consideration of: "*the likely significant effects on the environment, including on issues such as … human health*". The ***SEA Protocol*** (United Nations Economic Commission for Europe, 2003), which came into force in 2010, implements the political commitments made at the Third European Conference on Environment and Health and uses the term 'environment and health' throughout. It indicates that health authorities should be consulted at the different stages of the process and so goes further than the SEA Directive.

The WHO publication ***Health and Strategic Environmental Assessment (2009)*** provides advice from SEA and health experts on the further involvement of the health sector in SEA and strategic planning processes, in light of the stronger health requirements of SEA set out in the SEA Protocol and the 2004 Fourth Ministerial Conference on Environment and Health.

Publication 103: The 2007 Recommendations of the International Commission of Radiological Protection (2007) updates the System of Radiological Protection for the control of exposure from radiation sources. The Commission sets out three principles of radiological protection (justification, optimisation, and the application of dose limits) as well as the existence of planned, emergency, and existing exposure situations. ***Publication 122: Radiological Protection in Geological Disposal of Long-lived Solid Radioactive Waste (2013)*** explains how the system of radiological protection described in Publication 103 can be applied in the context of the geological disposal of long-lived solid radioactive waste. The report describes the different stages in the life time of a geological disposal facility, and addresses the relevant radiological protection principles for each stage.

The EU ***Basic Safety Standards (BSS) Directive*** (2013/59/Eurotom) was adopted on 5th December 2013. It lays down the basic safety standards for the protection of workers and the general public against the dangers arising from exposure to ionising radiation. It consolidates five previous directives and harmonises the EU regime with the Basic Safety Standards of the International Atomic Energy Agency.

UK

Many of the national level policies and strategies regarding health are aimed at understanding the trends and nature of health issues within the country, understanding the links between health issues and other related factors (such as economic status, etc.), and, primarily, at reducing the inequalities in health outlooks that are evident between different parts of the country and different sections of the population. Whilst some applicable policies/strategies are

contained within adopted strategies, many of the Government's objectives and intended actions are contained within White Papers and guidance papers.

The Health Protection Agency (now part of Public Health England) published ***A Children's Environment and Health Strategy for the United Kingdom (2009)*** to meet the UK commitments to the WHO's CEHAPE, and provides recommendations to the UK Government as to how it best can meet its commitment to the CEHAPE.

The Government White Paper: ***Implementing Geological Disposal White Paper (July 2014)*** sets out each of the devolved administrations' positions on radioactive waste management. The White Paper is issued jointly by the UK government and the Northern Ireland Executive. The Northern Ireland Executive has responsibility for ensuring that any proposed GDF will not have an adverse impact upon the environment, health or safety of Northern Ireland. A progress update was released in 2016, ***Implementing Geological Disposal: Annual Report April 2015 – March 2016***.

The ***Ionising Radiations Regulations 1999*** (SI 1999/3232) requires employers to keep exposure to ionising radiations 'As Low As Reasonably Practicable' (ALARP) and exposures must not exceed specified dose limits. Restriction of exposure should be achieved first by means of engineering control and design features. Where this is not reasonably practicable employers should introduce safe systems of work and only rely on the provision of personal protective equipment as a last resort. Any employer who undertakes work with ionising radiation must comply with IRR99. ***The Environmental Permitting (England and Wales) Regulations 2016*** specifies radiation dose limits for members of the public.

Application of the 2007 Recommendations of the ICRP to the UK: Advice from the Health Protection Agency (2009) advises UK bodies with responsibility for protection against radiation on the application of the UK recommendations for radiological protection issued by the ICRP. The document provides background to the recommendations, addresses the biological basis for the recommendations, outlines the ICRP system of protection and advises on implementation.

England

In England, the Department of Health is the government department responsible for public health issues. Its work includes setting national standards, shaping the direction of health and social care services and promoting healthier living.

The Government's White Paper ***Healthy Lives, Healthy People: Our strategy for public health in England (2010)*** recognises that the quality of the environment, including the availability of green space and the influence of poor air quality and noise, affects people's health and wellbeing. It detailed plans for a shift of power to local communities, including new duties and powers for local authorities to improve the health of local people.

In April 2013 (enacted by changes to the ***National Health Service Act 2006*** made by the ***Health and Social Care Act 2012***), unitary and upper tier local authorities took over a range of public health activity and as part of this reform the post of Director of Public Health (DoPH) was created. The role of the DoPH is to influence local services, for example joining up activity and services to improve public health.

Public Health England's ***From Evidence into Action: Opportunities to Protect and Improve the Nation's Health (2014)*** sets out seven health priorities for England for the next five years, namely tackling obesity; reducing smoking; reducing harmful drinking; ensuring every child has the best start in life; reducing dementia risk; tackling antimicrobial resistance; and reducing tuberculosis. The NHS ***Five Year Forward View (2014)*** sets out the vision for an improved

NHS to address changing health needs and demographics. This includes action on prevention of avoidable illnesses, empowering patients and engaging communities.

The ***National Planning Policy Framework (2012)*** sets out the core land use planning principles that should underpin both plan-making and decision taking. It includes a focus on developing healthy communities and states that the planning system can "play a role in creating healthy, inclusive communities and facilitating social interaction". The ***Planning Practice Guidance (DCLG, 2014)*** relating to health and wellbeing requires local planning authorities to "ensure that health and wellbeing, and health infrastructure are considered in local and neighbourhood plans and in decision making."

Scotland

The ***Public Health etc. (Scotland) Act 2008*** provides legislation for public health enabling Scottish Ministers, health boards and local authorities to better protect public health in Scotland. The Act defines "protecting public health" to mean protecting the community or any part of it from (i) infectious diseases, (ii) contamination, or (iii) other such hazards which constitute a danger to human health. Guidance has been produced to support the implementation of the Act including in respect of statutory nuisances.

Scottish Government's ***2020 Vision (2011)*** sets out its strategic vision for achieving sustainable quality in the delivery of healthcare services across Scotland, in the face of the significant challenges of Scotland's public health record, its changing demography and the economic environment. The ***Healthcare Quality Strategy for NHS Scotland (2010)*** aims to support "everyone in Scotland to live longer healthier lives and to participate more productively both economically and socially".

The Scottish Government's ***Scottish Planning Policy (2014)*** sets out how the planning system can help deliver more vibrant, successful and sustainable places, of which the choice to "live more active, engaged, independent and healthy lifestyles" is a key deliverable. The document also aims to tackle health and social problems and improve the health and well-being of people.

The ***National Planning Framework (NPF 3, 2014)*** for Scotland, as part of its vision, aims to enhance the health and well-being of people through promotion of sustainable transport and strengthening environmental and landscape quality.

Wales

The White Paper ***Sustainable Social Services for Wales: A Framework for Action (2011)*** highlighted a number of challenges faced by public services in Wales including demographic changes, increased expectations from those who access care and support as well as continuing hard economic realities. The ***Social Services and Well-being (Wales) Act 2014*** provides the legal framework for improving the well-being of people who need care and support, and carers who need support and to transform social services in Wales. It is based on the principles of well-being, people, partnership and prevention.

The ***Well-being of Future Generations (Wales) Act 2015*** includes 'a healthier Wales' as one of the seven well-being goals. This is supported by the National Indicators for Wales ***How to Measure a Nation's Progress? (2016)*** which specifies indicators relating to birth weight, healthy life expectancy, and healthy lifestyle behaviours for adults and children. ***Together for Health (2011)*** is a five-year vision for NHS Wales, based around community services and placing prevention, quality and transparency at the heart of healthcare. ***Working Differently – Working Together (2012)*** sets out key objectives, including to develop a workforce aligned

and committed to the Together for Health vision and to create a sustainable and skilled workforce that focuses on helping the people of Wales.

Public Health Wales's Strategic Plan for 2015-18, ***Creating a Healthier, Happier and Fairer Wales for Everyone***, sets priority areas for Wales including children's start in life, making healthy choices, and health threats such infections and air pollution.

Planning Policy Wales (PPW Edition 9) (2016) states the planning policies and proposals should contribute towards the protection and, where possible, the improvement of people's health and well-being. One of the main outcomes of the PPW is to ensure a strong, healthy and just society linked to the contribution of the well-being goals.

Overview of the Baseline

UK

In the UK, life expectancy at birth during the period 2013-2015 was 79.1 years for males and 82.8 years for females[96].

In England and Wales, cancer accounted for 28.5% of all deaths registered in 2016 and remained the most common broad cause of death for both men and women (30.8% of all male deaths and 26.2% of all female deaths registered in 2016). There have been fairly steady decreases in age-standardised mortality rates for the three main broad disease groups (cancer, respiratory and circulatory diseases) over the last decade. The overall rates for cancer decreased by 0.5% compared to 2015, however for females they increased by 0.1%.

Death rates from respiratory diseases (including influenza, pneumonia, chronic lower respiratory disease, bronchitis, emphysema and other chronic obstructive pulmonary diseases and asthma) are higher in the UK at 138.3 per 100,000 population than in any other EU Member State. In the UK, in 2016, there were 161.9 deaths per 100,000 males and 114.7 deaths per 100,000 females from respiratory diseases, compared to an EU average of 117.3 deaths per 100,000 males and 63.0 deaths per 100,000 females[97,98]. Circulatory diseases, such as heart disease and stroke remained the second most common broad cause of death, accounting for just over a quarter (25.5%) of all deaths registered in 2016. Mortality rates for circulatory diseases decreased compared to 2015 and are now lower than in 2014 for both males and females[99].

In 2013, more than one in three adults in Great Britain reported having a long-standing illness or disability, this increased slightly compared with 2012 but was in line with the levels seen between 2005 and 2012. One in five reported having a limiting long-standing illness or disability[100].

[96] ONS (2016) *National life tables, UK: 2013–2015.* Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/bulletins/nationallifetablesunitedkingdom/20132015

[97] Eurostat (2016) *Causes of Death Statistics*. Available online at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Causes_of_death_statistics

[98] ONS (2017) *Deaths registered in England and Wales 2016.* Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregistrationsummarytables/2016

[99] ONS (2017) *Deaths registered in England and Wales 2016.* Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregistrationsummarytables/2016

[100] ONS (2015) *Adult Health in GB, 2013.* Available online at: http://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/compendium/opinionsandlifestylesurvey/2015-03-19/adulthealthingreatbritain2013

There are high levels of hypertension and overweight/obesity in the UK[101]. Public health trends often correlate with deprivation and these figures for illness are invariably far less favourable in deprived areas[102].

The amount of natural radiation a person is exposed to varies around the world. Sources of natural radiation include cosmic rays from space and the presence of naturally occurring radioactive isotopes in food and water.

Public radiological dose limits in the UK (excluding natural background radiation and medical procedures) set out in the Ionising Radiations Regulations 1999 and Environmental Permitting (England and Wales) Regulations 2016 are:

- the sum of exposures should not exceed the dose limit of 1mSv[103] per year;
- the dose received from any new source must not exceed 0.3mSv per year; and
- the dose from the discharges from any single site must not exceed 0.5mSv per year.

Individual annual doses to members of the public from practices, other than medical procedures, are generally much less than the annual dose limit of 1 mSv. The average radiation dose (including natural background radiation and medical procedures) to the UK population in 2010 was assessed as approximately 2.7mSv/y[104], which was unchanged from a previous 2003 review. Around 84% of this is due to natural sources, particularly radon gas, which varies in intensity as a function of underlying geology. Radiation in the environment from the historic testing of nuclear weapons and the routine discharge of radioactivity by industry contributed less than 0.2% to the average dose, and occupational exposure contributed significantly less than 1% to the average dose.

The 2.7mSv is composed of: 1.3mSv radon and thoron; 0.27mSv intake of natural radionuclides (excluding radon); 0.35mSv terrestrial gamma radiation; 0.33mSv cosmic radiation; 0.005mSv weapons fallout; 0.0008mSv other anthropogenic radioactivity in the environment; 0.44mSv patient exposure from the medical use of radiation; and 0.0004mSv occupational exposure from the use of radiation.

The Ionising Radiations Regulations 1999 sets out that the annual radiation dose limit for workers is 20mSv/y (and for trainees, 6 mSv/y).

England

In England, life expectancy at birth during the period 2013-2015 was 79.4 years for males and 83.1 years for females.

In 2011, 47.2% of the population in England rated their health as very good; 34.2% as good, 13.1% as fair, 4.2% as bad and 1.2% as very bad[105].

[101] Health and Social Care Information Centre (2015) *Health Survey for England 2014: Trend Tables Commentary.* Available online at: http://content.digital.nhs.uk/catalogue/PUB19297/HSE2014-Trend-commentary.pdf
[102] ONS (2013) *General Health in England and Wales: 2011 and comparison with 2001*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/articles/generalhealthinenglandandwales/2013-01-30
[103] The Sievert (Sv) is a derived SI unit for ionising radiation. It provides an index for the risk of harm from radiation exposure.
[104] Public Health England (2016) *Ionising Radiation Exposure of the UK population: 2010 Review.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/518487/PHE-CRCE-026_-_V1-1.pdf
[105] ONS (2013) *General Health in England and Wales: 2011 and comparison with 2001.* Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/articles/generalhealthinenglandandwales/2013-01-30

The 2014 Health Survey for England, published in 2015, sets out the following key findings[106]:

- Overall, 11% of men and 13% of women aged 65 and over received help over the last month with at least one of the Activities of Daily Living (ADL) such as having a bath or shower, dressing or undressing and taking medicine.
- Mean BMI for both men and women was 27.2 kg/m^2, in the overweight range. Around a quarter of adults were obese (24% of men and 27% of women), and 41% of men and 31% of women were overweight.
- 22% of men and 16% of women drank more alcohol than the level considered to be at lower risk of alcohol-related harm.
- 26% of adults reported having ever been diagnosed with at least one mental illness.

Scotland

In Scotland, life expectancy at birth during the period 2013-2015 was 77.1 years for males and 81.1 years for females[96].

The 2015 Scottish Health Survey, published in 2016, sets out the following key findings[107]:

- 74% of adults aged 16 and over described their health as 'good' or 'very good'.
- 29% of adults were obese, while 65% were overweight including obese.
- 15% of adults reported ever having been diagnosed with cardiovascular disease (CVD).
- 6% of adults had doctor diagnosed diabetes.
- 29% of adults aged 16 and over had hypertension.

Wales

In Wales, life expectancy at birth for the period 2013-2015 was 78.4 years for males and 82.3 years for females.

In 2011, 46.6% of the population in Wales rated their health as very good; 31.1% as good, 14.6% as fair, 5.8% as bad and 1.8% as very bad.

The National Survey for Wales 2016-17 (which replaced the Welsh Health Survey), includes the following key findings[108].

- 59% of adults were classified as overweight or obese.
- 47% of adults had a physical or mental health condition or illness which was expected to last for 12 months or more.

[106] Health and Social Care Information Centre (2015) *Health Survey for England 2014 Trend Tables Commentary*. Available online at: http://content.digital.nhs.uk/catalogue/PUB19297/HSE2014-Trend-commentary.pdf

[107] Scottish Government (2016) *Scottish Health Survey 2015.* Available online at:**Error! Hyperlink reference not valid.** http://www.gov.scot/Resource/0050/00505745.pdf

[108] Welsh Government (2017) *National Survey for Wales*. Available online at: http://gov.wales/statistics-and-research/national-survey/?tab=el_home&topic=population_health&lang=en

- 33% of adults reported that their day-to-day activities were limited because of a health problem/disability, with musculoskeletal illnesses being the most common cause.

Summary of Existing Problems Relevant to the Geological Disposal NPS

The following existing problems for health have been identified:

- Health inequalities exist in many communities. This is due a number of factors (and the interplay between them) including housing quality, economic wellbeing, employment, lifestyle, heredity factors, cultural and environmental factors.
- Sustained exposure to elevated air pollution levels (including exposure to elevated concentrations of particulate matter, oxides of nitrogen and sulphur) contributes to this respiratory illness. According to WHO estimates, nearly 500,000 deaths in Europe in 2012 were linked to exposure to outdoor air pollution (WHO 2014)[109]. There is the potential for dust and other emissions to arise during the construction phase that are related to respiratory illnesses.
- Health problems associated with radiological exposure are generally a minor issue in the UK; the great majority of the average public dose comes from natural sources of radiation. Background levels of natural radiation vary considerably from area to area, with variations being significantly larger than public dose limits.

Likely Evolution of the Baseline

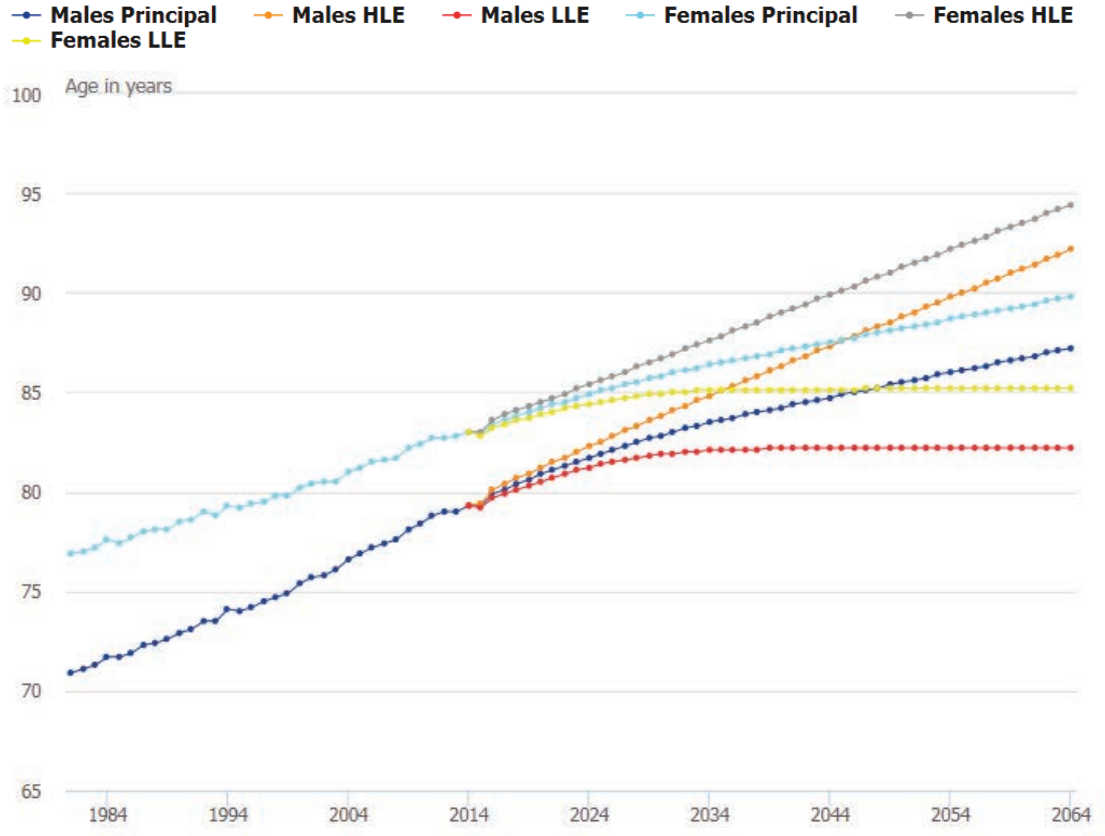
UK

Life expectancy[110] at birth in the UK has reached its highest level on record for both males and females. From 1982 to 2015, life expectancy at birth has increased from 70.8 to 79.1 years for males and 76.8 to 82.8 years for females[96].

Period life expectancy[111] at birth is projected to rise by eight years for males and seven years for females across the 50-year projection period 2014 – 2064. **Figure 3.1** shows period life expectancy at birth for males and females 1981-2014 and then for each of the variant life expectancy projections to 2064. Under the principal projection, a baby boy born in 2064 is projected to live to 87.2 years and a baby girl to 89.8 years. In the high life expectancy variant, period life expectancy at birth is projected to reach age 92.2 and age 94.4 for males and females respectively in 2064, but the low life expectancy variant projects period life expectancy as low as 82.2 and 85.2 respectively[112].

[109] WHO (2014) *Burden of disease from ambient air pollution for 2012.* Available online at: www.who.int/phe/health_topics/outdoorair/databases/AAP_BoD_results_March2014.pdf?ua=1
[110] The average period that a person may expect to live.
[111] Period life expectancy at a given age for an area is the average number of years a person would live, if he or she experienced the particular area's age-specific mortality rates for that time period throughout his or her life.
[112] ONS (2015) *Past and projected data from the period and cohort life tables: 2014-based, UK, 1981 to 2064*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/bulletins/pastandprojecteddatafromtheperiodandcohortlifetables/2014baseduk1981to2064

Figure 3.1 Period life expectancy at birth for males and females, UK, 1981-2064



Source: Office for National Statistics.

England

Life expectancy at birth for males in England has increased from 71.1 years in 1980-82 to 79.4 years in 2013-15, an increase of 8.3 years. For females, life expectancy increased by 6.0 years from 77.0 to 83.0 years over the same period. As a result, the gap in life expectancy between genders over this time has decreased from 6 years to 3.7 years.

Between 1993 and 2014, the proportion of the population in England reporting very good and good general health has fluctuated between 74% and 78% among men and between 73% and 76% among women, with no clear pattern of variation. The prevalence of very bad or bad general health has ranged from 4% to 8% across both sexes over the same period.

The current general trend in human health is generally towards greater life expectancy and healthier lifestyles, including reductions in smoking prevalence and excessive alcohol consumption, and increases in fruit and vegetable consumption and physical exercise over the last 10 years. However levels of obesity and the prevalence of certain conditions such as diabetes have increased across this period[113].

Scotland

Male life expectancy has improved across Scotland as a whole over the last 30 years (from 69.1 years in 1980-82 to 77.1 years in 2013-2015). Female life expectancy has also improved across Scotland, from 75.3 years in 1980-82 to 81.1 years in 2013-15. As a result, the gap in

[113] HSCIC (2014) *Health Survey for England 2014: Trend Tables Commentary*. Available online at: http://content.digital.nhs.uk/catalogue/PUB19297/HSE2014-Trend-commentary.pdf

life expectancy between genders over this time has decreased from 6.2 years to 4.1 years. Overall life expectancy in Scotland still lags behind the rest of the UK and most Western European nations.

All-cause mortality rates for young working-age adults (people aged 15-44) have declined in the last ten years from 119 in 2002–04 to 105 per 100,000 population in 2011–13. However, these rates remain relatively high compared to other Western European countries[114]. Alcohol related hospital admissions have been declining since 2007/08, while self-assessment of 'good' or 'very good' general health has stayed relatively stable between 74% and 77% over this period[115].

Wales

Life expectancy for males in Wales has increased from 70.4 years in 1980-82 to 78.4 years in 2013-15, an increase of 8 years. For females, life expectancy increased by 5.9 years from 76.4 to 82.3 years over the same period. As a result, the gap in life expectancy between genders over this time has decreased from 6 years to 4 years.

As of 2015, there has been a decrease in smoking rates in Wales since 2003/04, while obesity levels have increased during this time. There has also been a slight increase in adults reporting being treated for diabetes and mental illness, and levels of high blood pressure are higher than in 2003/04. By contrast, levels of heart conditions and arthritis have decreased. There has also been a slight decrease in reporting of 'fair' or 'poor' general health during this time.[116]

Assessing Significance

The objectives and guide questions related to health which have been identified for use in the appraisal of the effects of Geological Disposal Infrastructure NPS proposals are set out in **Table 3.1**, together with reasons for their selection.

Table 3.1 Approach to Assessing the Effects of the Geological Disposal Infrastructure NPS on Human Health

Objective/Guide Question	Reasoning
Objective: To protect and enhance health, safety and wellbeing of workers and communities and minimise any health risks associated with disposal operations.	The SEA Directive (2001/42/EC) requires that likely significant effects on human health be taken into account in the Environmental Report, which for the purposes of the AoS is incorporated within the AoS Report.
Will the Geological Disposal Infrastructure NPS protect and/or enhance the health and safety of workers, or other people working at any proposed sites?	All employers have a general duty to protect the health and safety of their employees and those affected by their work activities, as set out in the Health and Safety at Work etc. Act (1974).

[114] NHS Scotland (2015) *Health and Wellbeing Profiles 2015, Scotland Overview Report.* Available online at: http://www.scotpho.org.uk/opt/Reports/ScotPHO-Health-Wellbeing-Report-2015-150731-web.pdf
[115] Scottish Government (2016) *National Indicators: Reduce alcohol related hospital admissions; Improve self-assessed general health.* Available online at: http://www.gov.scot/About/Performance/scotPerforms/indicator
[116] Welsh Government (2016) *Welsh Health Survey*. Available online at: http://gov.wales/statistics-and-research/welsh-health-survey/?tab=previous&lang=en

Objective/Guide Question	Reasoning
Will the Geological Disposal Infrastructure NPS protect and/or enhance the health, safety and well-being of local communities and specific groups within those communities?	There is a duty to protect the health of the local communities, including more vulnerable members of the population, such as children as set out in WHO Children's Environment and Health Action Plan for Europe (CEHAPE) (2004) and the UK CEHAPE strategy (2009).
Will the Geological Disposal Infrastructure NPS protect and/or enhance the health, safety and well-being of wider communities (i.e. those communities that are not host to a GDF or deep boreholes)?	There is a duty to protect the health of the local communities, including more vulnerable members of the population, such as children as set out in CEHAPE (2004) and UK CEHAPE strategy (2009).
Will the Geological Disposal Infrastructure NPS disproportionately affect communities already identified as vulnerable / at risk?	There is a duty to protect the health of the local communities, including more vulnerable members of the population, such as children as set out in CEHAPE (2004) and UK CEHAPE strategy (2009).
Will the Geological Disposal Infrastructure NPS minimise the risk or consequences of a major accident?	Enables the consideration of the requirements of the Article 13(1)(c) of the Seveso III Directive that provides that in taking account of the need to prevent major accidents in land use policies where the siting or developments may be the source of or increase the risk or consequences of a major accident'.

Table 3.2 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the health objective.

Table 3.2 Illustrative Guidance for the Assessment of Significance for Human Health

Effect	Description	Illustrative Guidance
++	Significant Positive	• Option would have a significant positive effect on the likely determinants of good health (including employment opportunities, level of deprivation, physical activity, access to open space and recreational activities, improvements to environmental quality and community safety); • Option would have a strong and sustained positive effect on health and well-being and acknowledges the health needs of specific groups in society (e.g. children, mums to be and the elderly); • Option supports the provision of healthcare facilities.
+	Positive	• Option would have a positive effect on the likely determinants of good health (including employment opportunities, level of deprivation, physical activity, access to open space and recreational activities, improvements to environmental quality and community safety); • Option would have a positive effect on health and well-being and acknowledges the health needs of specific groups in society (e.g. children, mums to be and the elderly); • Option would support the provision of healthcare facilities (i.e. as a result of an increase in the local population linked with employment provision).

Effect	Description	Illustrative Guidance
0	Neutral	• Option would have no observable effects (short, medium and long-term) on the health and well-being of individuals, specific groups in society (e.g. children, mums to be and the elderly) and communities.
-	Negative	• Option would have a negative effect on the likely determinants of good health (including employment opportunities, level of deprivation, physical activity, access to open space and recreational activities, improvements to environmental quality and community safety); • Option would have a negative effect on the health and well-being of individuals, specific groups in society (e.g. children, mums to be and the elderly) and communities; • Option would result in some nuisance and/or disruption to communities, such that some complaints could be expected.
--	Significant Negative	• Option would have a significant negative effect on the likely determinants of good health (including employment opportunities, level of deprivation, physical activity, access to open space and recreational activities, improvements to environmental quality and community safety); • Option would have a significant negative effect on the health and well-being of individuals, specific groups in society (e.g. children, mums to be and the elderly) and communities; • Option would cause statutory nuisance or a sustained and significant nuisance and/or disruption to communities.
?	Uncertain	• From the level of information available the effect that the option would have on this objective is uncertain.

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 3.3 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria[117]' and 'No NPS' on the health AoS objective. The appraisal considers in-turn the three sub-sections used within Chapter 5 (Impacts) of the draft NPS: Applicant's Assessment; Decision Making and Mitigation. Account has also been taken of the approach taken to health impacts in EN- 1 (the overarching NPS for energy) and EN-6 (the NPS for nuclear power generation) and the extent to which that approach could or should be replicated in this draft NPS, given that it is intended to be a stand-alone NPS (as section 1.8 of the draft NPS states). The performance of the draft NPS and the two reasonable alternatives are scored accordingly, with a commentary provided in the Appraisal column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining

[117] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15 - 20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement. These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-term (less than 20 years), MT – medium-term (between 20 and 170 years) and LT – long-term (>170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

Table 3.3 Appraisal of the Draft NPS and Reasonable Alternatives: Human Health

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	**+**	**+**	**+/?**	**Draft NPS:** The draft NPS states: 5.9.4 "*The applicant should ensure that the impacts on the health of workers and the public are considered over the operational lifetime of the facility and post-closure. This should include any significant human health impacts identified as a result of assessment of other generic impacts in Part 5 of this NPS and their combined effects. Consideration of the impacts on human health, including cumulative impacts should be included in the Environmental Statement (see Section 4.2).*" *5.9.5 "The applicant should also consider any indirect health impacts that arise as a result of development. For example, if it in some way affects access to important public services, transport or the use of open space for recreation and physical activity."* *5.9.6 "The applicant should work with the local authority and the local Clinical Commissioning Group (CCG) to identify any potentially significant health impacts and appropriate mitigation measures at a given site. Where such measures relate to public information on the extent of risk in relation to radiological hazard, the applicant should consult Public Health England on the appropriate standards for radiological protection."* *5.9.7 "Radiological impacts on workers, the public and the environment will be assessed by the Office for Nuclear Regulation and the Environment Agency in safety submissions provided by the developer. These safety cases will inform the independent regulators' decisions on a Nuclear Site Licence and Environmental Permits. These permissions are not a prerequisite to granting development consent and are separate from the planning process."* Other topics in Section 5 make the link with health, e.g. noise, air quality and water quality. Relevant aspects of Section 5 that refer directly or indirectly to health are replicated below (our emphasis): Introductory text on Air Quality at 5.2.1: "*The development of geological disposal infrastructure can involve (non-radioactive) **emissions to air which could lead to adverse impacts on health**, on protected species and habitats, or on the wider countryside."* Introductory text on Air Quality at 5.2.2: "*Current UK legislation sets out **health-based ambient air quality objectives**. In addition, the European Union has established common, health-based and ecosystem based ambient concentration limit values for the main pollutants in the Ambient Air Quality Directive (2008/50/EC) ('the Air Quality Directive'), which Member States are required to meet by various dates."* Applicant's Assessment at 5.2.5: "*Air quality considerations are likely to be particularly relevant where geological disposal infrastructure is proposed within or adjacent to **Air Quality Management Areas (AQMAs)**".* The introductory text on noise states, at 5.3.1: *Excessive noise can have wide-ranging impacts on the **quality of human life and health** (e.g. owing to annoyance or sleep disturbance), use and enjoyment of areas of value (such as quiet places) and areas with high landscape quality. The Government's policy is set out in the Noise Policy Statement for England. It promotes good **health and good quality of life***

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				***through effective noise management**. Similar considerations apply to **vibration**, which can also cause damage to buildings. In this section, in line with current legislation, references below to "noise" apply equally to assessment of impacts of vibration.* Directive 2011/92/EU on the 'assessment of the effects of certain public and private projects on the environment', as amended by Directive 2014/52/EU, identifies human health (the new article 3 refers) as a topic to be considered. The amendments required by Directive 2014/52/EU had to be transposed by Member States by May 2017. Although the Government intends to leave the European Union, timescales are uncertain, as is the scope of replacement legislation and EU law will continue to have effect until that point. It is therefore beneficial that the NPS includes health as a stand-alone topic in Section 5 in anticipation of the requirements having effect for any DCO application made under the NPS. Text in the Applicants Assessment sets out the requirements for any assessment of noise. This includes an assessment of the effect of predicted changes in the noise environment on any noise-sensitive premises and noise-sensitive areas. Overall the draft NPS is assessed as having a positive effect against this objective because it requires that the applicant should ensure that the human health impacts (including indirect and cumulative effects) to workers and the public are considered, throughout the lifetime of the development, with appropriate mitigation measures identified. *Recommendations for Improvement* The section could provide more guidance on the anticipated scope and content of a health chapter for an Environmental Statement, thereby helping to provide clarity for the developer and other interested parties. It should encourage the avoidance of repetition within any Environmental Statement. Section 5.9.5 could highlight the need to consider the potential for impacts on the demand for health services and impacts on existing facilities, e.g. doctor's surgeries and hospitals in the host community.
				Draft NPS including Exclusionary Criteria: Given the anticipated scope of the exclusionary criteria and the importance of some of these assets for recreation and leisure there could be indirect health benefits associated with the use of exclusionary criteria. Short-term effects associated with perception of risk could be avoided as could short and medium-term effects associated with loss of access etc. However this would simply mean that such effects were displaced elsewhere, possibly to an area that is not designated but nevertheless important as a leisure and recreational resource.
				No NPS: Under this alternative health would be considered in accordance with amended EIA Regulations so the assessment is positive but uncertain because the scope of any assessment has yet to be defined. There is clearly an opportunity for the NPS to provide clarity and further guidance with Section 5 outlining the broad scope of any assessment in relation to health as it does. This helps provide certainty to a developer in terms of preparing applications and other interested parties.
Decision making	**+**	**+**	**+/?**	**Draft NPS:** 5.9.8 "*The detailed consideration of the implications, if any, for human health is the responsibility of the independent*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				regulators. However, planning operates in the public interest to ensure that the location of proposed development is acceptable and health can be material to such decisions. The Secretary of State should take account of health concerns when setting requirements relating to the range of impacts set out in this NPS. " *5.9.9 "The Secretary of State should also consider the positive effect of employment and other socio-economic impacts (see Section 5.7 above) on human health and well-being."* *5.9.10 "The Secretary of State should act on the basis that the regulatory regime will be properly applied and enforced to protect human health."* The draft NPS is assessed as positive against this objective because it identifies the role of health as a planning consideration. It also recognises the role of other regimes in relation to pollution control. **Draft NPS including Exclusionary Criteria:** Given the anticipated scope of the exclusionary criteria and all other things being equal there is no anticipated difference between the draft NPS with and without exclusionary criteria in relation to this part of the Strategy. **No NPS:** Under this alternative health would be considered in accordance with amended EIA Regulations so the assessment is positive but uncertain because the scope of any assessment that would feed into the decision making process would need to be agreed. There is clearly an opportunity for the NPS to provide clarity and further guidance with Section 5 outlining the broad scope of any assessment in relation to health as it does. This helps provide certainty to a developer in terms of preparing applications and other interested parties.
Mitigation	**0**	**0**	**?**	**Draft NPS:** 5.9.11 *"The Secretary of State should act on the basis that the risk of adverse effects resulting from exposure to radiation for workers, the public and the environment will be adequately mitigated because of the need to satisfy the requirements of the UK's strict legislative and regulatory regime.* Arguably the above text would sit better under 'Decision Making.' As the draft NPS does not identify any specific mitigation measures under health it has been assessed as having no significant effects, since positive effects are already reflected in the assessment for other relevant sections. *Recommendations for Improvement* Cross referencing mitigation in other relevant sections, e.g. noise, air quality and water quality would be appropriate as it avoids repletion. However the mitigation could also acknowledge the relevance of wider determinants of health (both mental

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				and physical), be more specific and clearly reflect the potential effects associated with the key project stages of site investigation, construction, operation and closure, as summarised below.[118] It is recognised that there will be overlap between these stages and the mitigation appropriate to them. A Generic Health Impact Assessment for a Geological Disposal Facility has been prepared (Radioactive Waste Management Ltd., December 2016), it is a detailed document and the text below draws from that. *Site Investigation* Borehole site activities could result in effects on air quality, noise, light pollution and views / landscape. Because of their relatively small scale of these activities such effects are considered unlikely to be significant, but over a limited period they could influence how frequently and effectively people use any nearby recreational and amenity facilities and the outdoors more generally for recreation. Appropriate mitigation could include preparation of an Environmental Management Plan (which could include consideration of the location of boreholes away from areas used for recreation and physical activity). *Construction* During this phase of development, there are potential effects on levels of recreational and physical activity related to transport and environmental effects. These could include alterations to the road network or increases in construction traffic, which could influence actual or perceived levels of safety in the vicinity of a site, resulting in potential changes in access to recreational and amenity facilities and levels of physical activity. Other effects such as changes in noise levels, visual amenity and air quality could also affect sensitive members of the community (those with respiratory illnesses living adjacent to principal traffic routes) and could influence levels of physical activity, as changes could alter people's enjoyment or use of local recreational and amenity facilities and resources. Appropriate mitigation could include preparation of an Environmental Management Plan for the construction phase. Other measures could include improvements to local public transport services, helping to reduce any severance from recreational and amenity features caused by changes to the local road network and helping to reducing congestion. They might also include creation of new transport infrastructure such as roads, footpaths and cycle-ways, which could provide or improve access to existing recreational and amenity facilities. *Operation & Closure* Before a GDF can be constructed and waste emplacement operations can commence, regulatory approvals are needed from the Office for Nuclear Regulation (ONR) and the relevant UK environment agency (such as the Environment Agency or Natural Resources Wales). To obtain regulatory approval, the developer will have to demonstrate, amongst other things, that

[118] Radioactive Waste Management Ltd (December 2016) *Geological Disposal Generic Health Impact Assessment*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				the radiological risk to individual members of the public and the population as a whole will be as low as reasonably achievable (ALARA), consistent with Schedule 23 of the Environmental Permitting Regulations 2016 – as well as being within statutory dose limits. Once closed, a GDF would safely contain and isolate radioactive waste for the very long term, preventing the release of radioactivity back to the surface environment in quantities that would cause measurable health effects. Mechanisms by which radioactivity might return to the surface environment include inadvertent human intrusion, geological events and processes that might disrupt safety barriers and groundwater movement. A Post-closure Safety Assessment would be required to address these issues. Wider health effects are likely to be largely similar to those during construction. Although the nature of effects would remain largely unchanged between the construction and operation phases, the extent / scale of any adverse effects is likely to be reduced as activities will be less intensive than those required during the initial construction phase, and any mitigation and enhancement measures such as landscaping, habitat management and creation should be starting to have an appreciable effect. This may encourage visits to and usage of recreational and amenity features in the area, particularly if infrastructure such as footpaths and cycle-ways has been created or improved as part of project implementation. Health effects associated with closure are likely to be largely similar to those during construction. However, the scale of these effects during closure/ post-closure phase would be greatly reduced. The nature of site restoration would be agreed with the local community, but there may be potential for net enhancements to recreation and amenity facilities and levels of physical activity if the site is restored to an appropriate end-use. This may require some short-term construction activities which would again need to be mitigated using measures such as those outlined above.
				Draft NPS including Exclusionary Criteria: Given the anticipated scope of the exclusionary criteria and the importance of some of these assets for recreation and leisure there could be indirect health benefits associated with the use of exclusionary criteria. Short-term effects associated with perception of risk could be avoided as could short- and medium-term effects associated with loss of access etc. However this would simply mean that such effects were displaced elsewhere, possibly to an area that is not designated but nevertheless important as a leisure and recreational resource.
				No NPS: Under this alternative health would be considered in accordance with amended EIA Regulations so the assessment and associated mitigation could be similar to that of the draft NPS and other alternative but this is uncertain. There is clearly an opportunity for the NPS to provide clarity and further guidance with Section 5 outlining the broad scope of any assessment in relation to health as it does. This helps provide certainty to a developer in terms of preparing applications and other interested parties.
Other Sections of the Draft NPS Relevant to Health	**1. Introduction** 1.1.3 There is an opportunity for the consideration of effects on health in a specific locality through the preparation of a local impact report submitted by a local authority in accordance with the Planning Act. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on health as an issue, helping to ensure that consideration is given to local issues.			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	1.1.4 Consideration of health interests is reflected in the need to apply the NPS in the context of section 104 of the Planning Act. This should help ensure that health related effects, (both positive and negative), in so far as they are relevant to planning, are balanced. The net result of this balancing exercise could be uncertain, however. In respect of health it is important to acknowledge that there are other safeguards that sit outside of the balancing exercise, relating to site licensing and permitting (see 2.4.8 below). Sections 1.1.14 and 1.1.15 outline the process by which the relevant independent statutory regulators assess the nuclear safety, security and environmental protection of the facility, which is also distinct from the application for development consent. **1.4 Consideration of deep boreholes investigations** – the role and content of an Environmental Statement, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of health interests, including the potential for cumulative effects – by setting out these principles the NPS has a positive impact in relation to the consideration of health and other issues as part of the consenting process. **1.5 Consideration of geological disposal facilities** - This section of the draft NPS sets out the likely timescales associated with a GDF and the need to consider potential long-term impacts of the facility. **2. Government Policy on Management of Higher Activity Radioactive Waste** 2.2.6 The preference for disposal through a single site will help to confine effects to a specific area thus limiting the likely extent of any effects on health, although these could still be significant in respect of that particular site. 2.4.3 The strategy for implementation provides for the opportunity to consider health interests as the process proceeds iteratively, including discussions with communities of interest. 2.4.8 The NPS highlights that physical construction of a geological disposal facility will only be able to begin once a nuclear site licence has been granted by the independent nuclear safety and security regulator, the Office for Nuclear Regulation (ONR). Before the start of radioactive waste emplacement, an environmental permit for radioactive waste disposal will also be required from the Environment Agency. This highlights the protection to health afforded by other regulatory regimes. **3. The Need for Geological Disposal Infrastructure** The identification of technical and ethical considerations which prompt the need to provide for a GDF will benefit health interests through the adoption of a responsible approach to waste disposal. As such, this lessons the risk to society, including those associated with health over a wide area through leakage of radioactive materials (for various reasons). **4. Assessment Principles** **4.1 General principles of assessment** – The provisions of the Planning Act and the policies and protections set out in the NPS provide for a balanced consideration of needs. The requirement for the identification of adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for the protection and enhancement of health interests. In the case of health there is another tier of protection provided by other legislative provisions and these are outlined in the draft NPS at 1.1.14 and 1.1.15. **4.2 Environmental Impact Assessment** – Directive 2011/92/EU on the 'assessment of the effects of certain public and private projects on the environment', as amended by Directive 2014/52/EU, identifies human health (the new article 3 refers) as a topic to be considered. This requirement would exist in the absence of the NPS. The section highlights the need to ensure that the expected effects deriving from the vulnerability of the project to risks of major accidents and/or disasters are considered. The applicant should make reference to the safety case in which consideration is given to major accidents and/or disasters in the Environmental Statement.			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				4.3 Habitats Regulations Assessment – - no direct relationship identified. **4.4 Alternatives** – the requirement that reasonable alternatives will need to be considered as part of scheme design and project planning should ensure that health related issues are taken into account, both in terms of protection and opportunities for mitigation and enhancement. **4.5 Criteria for 'good design for geological disposal infrastructure** - 4.5.4 notes that: "*A good design should meet the principal objectives of the scheme by eliminating or substantially mitigating the significant impacts, by improving operational conditions and simultaneously minimising adverse impacts."* **4.6 Climate Change Adaptation** – Ensuring that the GDF is adapted to long-term climate change will help avoid any health impacts associated with damage to the GDF. **4.7 Pollution Control and other Environmental Regulatory Regimes** – This section highlights the interface between planning and pollution control. Paragraph 4.7.5 states: "*In deciding an application, the Secretary of State should consider whether the development itself is an acceptable use of the land. To inform decision making, he should assess the potential impacts of processes, emissions and discharges rather than their control. He should work on the assumption that in terms of the control and enforcement of these factors, the relevant pollution control regime will be properly applied and enforced by the independent regulators. Decisions under the Planning Act should complement but not duplicate those taken under the relevant pollution control regime."* **4.8 Common Law Nuisance and Statutory Nuisance** – 4.8.2 notes that: *"It is very important that, during examination of a nationally significant infrastructure project, the Examining Authority considers possible sources of nuisance under Section 79(1) of the Environmental Protection Act 1990, and how they may be mitigated or limited. This will enable the Examining Authority to recommend appropriate requirements that the Secretary of State may wish to include in any subsequent order granting development consent."* Provisions in relation to statutory nuisance will help ensure that significant effects in relation to health, e.g. relating to noise are avoided. **4.9 Safety** – The NPS highlights the role of other safety regimes and the need for the Secretary of State to have regard to health and safety legislation applying to the construction and operation of geological disposal infrastructure. **4.10 Health** – This section highlights the need for the Environmental Statement to consider effects on human beings and include measures to avoid, reduce or compensate such impacts as appropriate. The effects include access to land uses, including employment, open space and water for recreation and physical activity (4.10.1 refers). The potential for impacts to simultaneously affect people and the need to take account of this is highlighted. **4.11 Security Considerations** – This section of the draft NPS outlines established security considerations and responsible Government departments, which would apply to a GDF. These considerations would apply irrespective of whether or not the NPS was in place so no additional environmental effects are anticipated.
Summary Appraisal of Likely Significant Effects	**+**	**+**	**+/?**	**Draft NPS:** The stand-alone consideration of health in Section 5 of the draft NPS contributes positively to this objective by highlighting health as a material consideration. Other topics in Section 5 make the link with health, e.g. noise, air quality and water quality. The decision making criteria for this objective relate to health and safety of workers and the wider community. These considerations fall under other legislative provisions but the NPS makes a positive contribution in terms of considering the wider determinants of health. The overall effect associated with the draft NPS as currently drafted is assessed as a minor positive effect on that basis. By ensuring that long-term provision is made for the management of waste in the inventory for disposal, the NPS minimises the risk or consequences of a major accident that could impact on health arising from current interim storage of higher activity wastes. As the NPS notes the transportation of waste falls outside of the decision making process in this instance. A bespoke section on health as contained in Section 5 provides the opportunity to ensure that the health and safety of workers and the health, safety and well-being of local communities is optimised. This would include consideration of broader

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				determinants of health to those covered by other regulatory regimes relating to health and safety and pollution control etc. It is assumed that under all of the reasonable alternatives the protection to health afforded by other regulatory regimes would remain in place.
				Draft NPS including Exclusionary Criteria: Given the anticipated scope of the exclusionary criteria and the importance of some of these assets for recreation and leisure there could be indirect health benefits associated with the use of exclusionary criteria. Short-term effects associated with perception of risk could be avoided as could short- and medium-term effects associated with loss of access etc. However this would simply mean that such effects were displaced elsewhere, possibly to an area that is not designated but nevertheless important as a leisure and recreational resource. It is assumed that under all of the reasonable alternatives the protection to health afforded by other regulatory regimes would remain in place.
				No NPS: Whilst proposals could still be considered in the context of Council Directive 2011/70/Euratom which broadly accepts at the technical level, at this time, deep geological disposal represents the safest and most sustainable option as the end point of the management of high-level waste and spent fuel considered as waste. There would be uncertainty as to whether or not there was need for such a facility and could also make it harder to secure the deep boreholes necessary to determine the suitability of sites for a GDF. There could be uncertainty over the very long term as waste continued to be stored in surface facilities. It is assumed that under all of the reasonable alternatives the protection to health afforded by other regulatory regimes would remain in place.
Summary of Recommended Mitigation and Enhancement	Given that Directive 2011/92/EU on the 'assessment of the effects of certain public and private projects on the environment', as amended by Directive 2014/52/EU, identifies human health (the new article 3 refers) as a topic to be considered, the fact that the NPS includes health as a stand-alone topic in Section 5 is welcomed. Including guidance on health in Section 5 differentiates it from the no NPS alternative. The overall assessment recognises that there could be a distinction to be made between the NPS with and without exclusionary criteria but it is difficult to be certain. Given the anticipated scope of the exclusionary criteria and the importance of some of these assets for recreation and leisure there could be indirect health benefits associated with the use of exclusionary criteria. Short-term effects associated with perception of risk could be avoided as could short- and medium-term effects associated with loss of access etc. However this would simply mean that such effects were displaced elsewhere, possibly to an area that is not designated but nevertheless important as a leisure and recreational resource. As the NPS is intended to be a stand-alone document Section 5 would need to include guidance on the scope of any assessment in relation to health, consistent with EN-1 and EN-6. This should include the need to consider direct and indirect effects relating to both mental and physical health. Anxiety and stress is mentioned in 5.9.2. The extent to which this would be a material planning consideration is unclear but in any event the statement does not say anything about how the issue should be considered or mitigated against if appropriate, further clarity, and if appropriate, guidance could be provided in Section 5.			

4. Land Use, Geology and Soils

Introduction

This section presents the overview of plans, programmes and baseline information for the appraisal of sustainability of the National Policy Statement for Geological Disposal Infrastructure and reasonable alternatives in respect of land use, geology and soils.

Land use in this context is concerned with the effective use of land, i.e. by encouraging the reuse of land that has been previously developed (brownfield land) as well promoting sustainable patterns of land use, e.g. in relation to the protection of open spaces and green infrastructure. Geology and soils is concerned with important geological sites, the contamination of soils and high quality agricultural land.

There are links between the land use, geology and soil topic and other topics in the Appraisal of Sustainability (AoS), including biodiversity and nature conservation, human health, climate change, waste and resources and landscape and townscape.

Review of Plans and Programmes

The government's stated aim for soils in *Safeguarding our Soils, A Strategy for England* is that all soils are managed sustainably by 2030 and degradation threats are tackled quickly. Planning policy also provides the context both for the prevention and remediation of contaminated land. Requirements are also in place for the remediation of radioactive contaminated land. The NPPF and supporting Planning Practice Guidance encourage the effective use of land by reusing land that has been previously developed, provided that it is not of high environmental value. Planning authorities should also take into account the economic and other benefits of the best and most versatile agricultural land. Through promoting the effective use of land, the sustainable use of soils and the remediation of contaminated land, the plans and programmes provide a framework for considering land use, the protection of soil and geological features.

International/European

The first ***World Soil Charter*** was adopted in 1981 by members of the Food and Agriculture Organization of the United Nations (FAO), which highlighted key principles and guidelines related to soil conservation. In 2015, member countries endorsed an updated World Soil Charter to promote sustainable soil management at all levels.

The ***European Thematic Strategy on Soil Protection (2006)*** sets out the European Commission's strategy on soils. The overall objective of the Strategy is the protection and sustainable use of soil, based on the following guiding principles:

- preventing further soil degradation and preserving its functions;
- when soil is used and its functions are exploited, action has to be taken on soil use and management patterns;
- when soil acts as a sink/receptor of the effects of human activities or environmental phenomena, action has to be taken at source; and

- restoring degraded soils to a level of functionality consistent at least with current and intended use, thus also considering the cost implications of the restoration of soil.

The Strategy also included a proposal for a Soils Directive. However, the proposal for a Directive has since been withdrawn (May 2014) with the Commission stating that it "*remains committed to the objective of the protection of soil*". The commitment to sustainable soil use is in line with the **Seventh Environment Action Programme**, (7th EAP) which provides that by 2020 "*land is managed sustainably in the Union, soil is adequately protected and the remediation of contaminated sites is well underway*" and commits the EU and its Member States to "*increasing efforts to reduce soil erosion and increase organic matter, to remediate contaminated sites and to enhance the integration of land use aspects into coordinated decision-making involving all relevant levels of government, supported by the adoption of targets on soil and on land as a resource, and land planning objectives*". It commits the EU and its Member States to increasing efforts to reduce soil erosion, increase soil organic matter and to remediate contaminated sites. This reiterates a number of soil and land use commitments in the ***2011 Road Map for Resource-Efficient Europe*** (part of Europe 2020). The EAP builds on the commitments of the ***2012 United Nations Conference on Sustainable Development (Rio+20)*** which recognises the economic and social significance of good land management, and calls for a 'land degradation neutral world'.

The ***Industrial Emissions Directive (IED) (2010/75/EU)*** combines seven previous directives, including the Large Combustion Plant Directive and the Integrated Pollution Prevention and Control (IPPC) Directive. It applies an integrated environmental approach to the regulation of certain industrial activities, which means that emissions to air, water and land must be considered together. Regulators must set permit conditions so as to achieve a high level of protection for the environment as a whole, based on the use of the best available techniques (BAT), which balances the costs to the operator against the benefits to the environment. The Directive specifies that permit conditions must be included to ensure the protection of soil quality.

A number of other European Directives contribute indirectly to soil protection including the ***Habitats Directive (92/43/EEC)***, ***Ambient Air Quality and Cleaner Air for Europe Directive (2008/50/EC)***, ***Water Framework Directive (WFD) (2000/60/EC)***, ***Nitrates Directive (91/676/EEC) and Sewage Sludge Directive (86/278/EEC)***.

UK

The ***Environmental Protection Act 1990*** defines within England, Scotland and Wales the legal framework for duty of care for waste, contaminated land and statutory nuisance.

The ***Environment Act 1995*** seeks to protect and preserve the environment and guard against pollution to air, land or water. The Act adopts an integrated approach to environmental protection and outlines where authorisation is required from relevant authorities to carry out certain procedures as well as outlining the responsibilities of the relevant authorities. The Act also amends the Environmental Protection Act 1990 with regard compulsory remediation of contaminated land.

The ***Wildlife and Countryside Act 1981*** allows the designation of Sites of Special Scientific Interest (SSSI) for sites with geological importance.

The ***Environmental Permitting (England and Wales) Regulations 2016*** (SI 2016/1154) consolidates a range of previous permits required for processes which might cause pollution. It covers water discharges, groundwater activities, radioactive substances, waste, mining and

installations. It requires operators to obtain permits for some facilities, to register others as exempt and provides for ongoing supervision by regulators. The aim of the regime is to:

- protect the environment so that statutory and Government policy, environmental targets and outcomes are achieved;
- deliver permitting and compliance with permits and certain environmental targets effectively and efficiently in a way that provides increased clarity and minimises the administrative burden on both the regulator and the operators;
- encourage regulators to promote best practice in the operation of facilities; and
- continue to fully implement European legislation.

The Forestry Commission's ***National Forest Inventory*** takes place every 10-15 years, with the most recent beginning in 2009. It provides a record of key information about the Great Britain's forests and woodlands. This information is useful to many people and organisations involved in forestry and land management, as well as in the wider world of planning, policy development and business.

The ***Ancient Woodland Inventory***[119] identifies woodlands that have had a continuous woodland cover for centuries. Studies show that these woodlands are typically more ecologically diverse, and of higher nature conservation value, than those that have developed recently or those where woodland cover on the site has been intermittent. They may also be culturally important.

England

In 2009, Defra published ***Safeguarding our Soils, A Strategy for England***. The vision in this Strategy is that by 2030, all of England's soils will be managed sustainably and degradation threats will be tackled successfully. The overall aspiration is that this will improve the quality of England's soils and safeguard their ability to provide essential services for future generations. In June 2011, the Government reiterated its vision and 2030 target for England's soils in the ***Natural Environment White Paper (Defra, 2011)***. As part of this vision, the Government committed to undertaking further research to explore how soil degradation can affect the soil's ability to support vital ecosystem services; and how best to manage lowland peatlands in a way that supports efforts to tackle climate change. This will inform future policies and the direction of future action towards 2030.

The ***Contaminated Land (England) Regulations 2006*** (SI 2006/1380) sets out provisions relating to the identification and remediation of contaminated land. The ***Environmental Damage (Prevention and Remediation) (England) Regulations 2015*** (SI 2015/810) require action in response to the most significant cases of environmental damage including in respect of risks to human health from contamination of land.

The ***Radioactive Contaminated Land (Modification of Enactments) (England) Regulations 2006*** (SI 2006/1379) (as amended) amends the Environmental Protection Act 1990 and are concerned with the remediation of land contaminated with radioactive substances in certain circumstances.

In 2012 the Government revised Statutory Guidance for radioactive and non-radioactive contaminated land under Part 2A of the Environmental Protection Act 1990, following a review

[119] Actively maintained by Natural England, Natural Resources Wales, Scottish Natural Heritage and the Woodland Trust in Northern Ireland.

of the contaminated land regime in England (similar guidance was also issued in Scotland and Wales). This revised Statutory Guidance while still taking a precautionary approach, allows regulators to make quicker decisions about whether or not land is contaminated under Part 2A. It also offers better protection against potential health impacts by concentrating on the sites where action is actually needed.

The ***National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2012)*** sets out the Government's planning policy for the use of land in England. With specific regard to geology and soils, it 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 pollution or land instability; and remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate" (paragraph 109). The NPPF states that planning policies should encourage the effective use of land by reusing land that has been previously developed, provided that it is not of high environmental value (paragraph 111). Planning authorities should also take into account the economic and other benefits of the best and most versatile agricultural land. Where significant development of agricultural land is demonstrated to be necessary, local planning authorities should seek to use areas of poorer quality land in preference to that of a higher quality (paragraph 112).

In 2014, the Department for Communities and Local Government (DCLG) published online Planning Practice Guidance. Sections of specific relevance include *Land Affected by Contamination (2014)* in addition to *Brownfield Land, Soils and Agricultural Land (2014)* and *Green Infrastructure (2016)* under the 'Natural Environment' guidance.

Local Plans set out the policies for the use of land at the local level including in respect of minerals and waste and must be prepared in accordance with the NPPF and under the ***Planning and Compulsory Purchase Act 2004***.

Scotland

The main aim of the ***Scottish Soil Framework (2009)*** is to promote the sustainable management and protection of soils consistent with the economic, social and environmental needs of Scotland. The Framework identifies a wide range of activities that will contribute to 13 soil outcomes, including factors such as maintaining soil structure, reducing soil erosion and where possible remediating, maintaining and enhancing soil's productive capacity.

Scottish Planning Policy (2014) sets out the Scottish Government's policy on land use planning. The SPP states that the planning system should seek to protect soils from damage such as erosion or compaction and limits development on prime agricultural land.

The third ***National Planning Framework (NPF3)*** was published in June 2014 and sets the spatial expression of the Scottish Government's Economic Strategy, and of plans for development and investment in infrastructure. The NPF identifies national developments and other strategically important development opportunities in Scotland.

Planning Advice Note 33: Development of Contaminated Land (PAN33) (Revised October 2000) provides advice on implications of the development of contaminated land and the approach to contaminated land in development plans.

Scotland's second land use strategy, ***Getting the Best from Our Land: A land use strategy for Scotland 2016-2021***, was published in 2016. It retains the long-term vision; three Objectives relating to the economy, environment and communities; and the Principles for

Sustainable Land Use from the first land use strategy. It takes a strategic approach to the challenges facing land use in Scotland and sets out the following vision: "A Scotland where we fully recognise, understand and value the importance of our land resources, and where our plans and decisions about land use deliver improved and enduring benefits, enhancing the wellbeing of our nation." This vision is underpinned by the following objectives:

- land based businesses working with nature to contribute more to Scotland's prosperity;
- responsible stewardship of Scotland's natural resources delivering more benefits to Scotland's people; and
- urban and rural communities better connected to the land, with more people enjoying the land and positively influencing land use.

Local Development Plans are prepared by local councils and set out more detailed policies and proposals to guide development. Additionally, in the four main cities (Aberdeen, Dundee, Edinburgh and Glasgow) and their surrounding areas the development plan also includes ***Strategic Development Plans.***

A scheme for remedying contaminated land is introduced in the ***Contaminated Land (Scotland) Regulations 2000*** (SSI 2000/178) and ***Contaminated Land (Scotland) Regulations 2005*** (SSI 2005/658). This scheme identifies special sites' enforced by Scottish Environment Protection Agency (SEPA), remediation notices and their contents, and sets out the information to be held on a contaminated land register maintained by local councils. The ***Pollution Prevention and Control (Scotland) Regulations 2012*** (SSI 2012/360) permit and regulate many industrial activities that may pollute our environment. The ***Environmental Liability (Scotland) Regulations 2009*** (SSI 2009/266) oblige operators of certain activities to take preventative measures where there is an imminent threat of environmental damage, and to remediate any environmental damage caused by their activities.

The ***Radioactive Contaminated Land (Scotland) Regulations 2007*** (SSI 2007/179) (as amended) extend the Environmental Protection Act 1990, and provide regulations for access to and identification of land that may be contaminated by radioactivity. Where such land is causing lasting exposure of radiation to any person or where there is a significant possibility of such exposure, the regime will also allow for remediation, under circumstances where intervention is liable to be justified.

The ***Scottish Forestry Strategy (2006)*** also includes objectives relating to sustainable soil management and protection.

Wales

The ***Well-being of Future Generations (Wales) Act 2015*** strengthens existing governance arrangements for improving the well-being of Wales to ensure that present needs are met without compromising the ability of future generations to meet their own needs. The act identifies goals to improve the well-being of Wales, introduces national indicators that will measure the difference being made to the well-being of Wales, and simplifies requirements for integrated community planning. The 2016 national indicators include the 'concentration of carbon and organic matter in soil'. This is supported by the ***Environment (Wales) Act 2016***, which puts legislation in place to plan and manage Wales' natural resources in a more proactive, sustainable and joined-up way, and includes provisions relating to land management.

One Wales: One Planet (2009) sets out proposals to promote sustainable development, how the Welsh Government will make sustainable development a reality for people in Wales, and

the benefits that people will see from this, particularly in less well-off communities. With specific regard to land-based resources, the strategy's aim is to "meet the needs of current and future generations without depleting the resources provided by land upon which we all depend". The Welsh Government's ***Natural Resources Policy Statement (2015)*** also illustrates key priorities including soil, green infrastructure, woodlands and peat management.

The ***Wales Spatial Plan (2008)*** provides the context and direction of travel for local development plans and the work of local service boards. The 2008 update brings the Wales Spatial Plan into line with One Wales, and gives status to the area work which has developed since 2006. The key themes of the update (and the Wales Spatial Plan before it) are set out below:

- Building Sustainable Communities;
- Promoting a Sustainable Economy;
- Valuing our Environment;
- Achieving Sustainable Accessibility; and
- Respecting Distinctiveness.

The ***Planning (Wales) Act 2015*** sets out a series of legislative changes to deliver reform of the planning system in Wales. This includes the requirement for a National Development Framework which will set out the Welsh Government's land use priorities and Strategic Development Plans for areas with matters of greater than local significance.

Planning Policy Wales (Edition 9) (2016) contains current land use planning policy for Wales. It promotes a preference for the reuse of brownfield land and conservation of the best and most versatile agricultural land and geological assets. Chapter 13 deals with minimising and managing environmental risks and pollution including contaminated and unstable land and seeks to maximise environmental protection for people, natural and cultural resources, property and infrastructure and prevent or manage pollution and promote good environmental practice. Chapter 14 addresses mineral extraction and related development in Wales, which includes all minerals and substances in, on or under land extracted either by underground or surface working.

Technical Advice Note 5: Nature Conservation and Planning (2009) includes guidance relating to conservation of geological features such as rocks and soils. ***Technical Advice Note 6: Planning for Sustainable Rural Communities (2010)*** provides guidance on how the planning system can contribute to: sustainable and rural communities; sustainable rural housing; sustainable rural services; and sustainable agriculture.

Local Development Plans (LDPs) set out local planning authority proposals and policies for future development and use of land in Wales. As of February 2017, 18 authorities had an adopted LDP with the remainder relying on extant adopted and emerging Unitary Development Plans.

The ***Contaminated Land (Wales) Regulations 2006*** (WSI 2006/2989) sets out provisions relating to the identification and remediation of contaminated land. The ***Environmental Damage (Prevention and Remediation) (Wales) Regulations 2009*** (WSI 2009/995) require action in response to the most significant cases of environmental damage including in respect of risks to human health from contamination of land.

The ***Radioactive Contaminated Land (Modification of Enactments) (Wales) Regulations 2006*** (WSI 2006/2988) as amended modify the Environmental Protection Act 1990 to cover land contaminated with radioactivity, including from nuclear installations.

Woodlands for Wales (2009) is the Welsh Government's strategy for woodlands and trees, which is supported by woodland Policy Position statements including ***Water and Soils (2010)*** which has the following objectives:

- woodland management achieves high standards of environmental stewardship where water quality, water resources, soil resources, soil carbon and soil function are safeguarded and enhanced;
- more existing woodland is brought into appropriate and sustainable management and delivers high quality ecosystem services, particularly in catchments at risk of failing good ecological and chemical status; and
- woodland and trees are better integrated into wider land management practices (especially agriculture) where new woodland and trees support improved environmental, water and soil services and functions (including urban areas).

Overview of the Baseline

UK

Geology

The geology of the UK is diverse and has almost 700 soil types in England and Wales alone[120]. As a broad overview the following rock types exist in a progression from North West to South East (predominant rock types): Tertiary Volcanic Rocks; Crystalline Rock of Pre-Cambrian and later age; Lower Carboniferous to Cambrian; Triassic and Permian; Early Precambrian and Devonian; Jurassic; Cretaceous; Tertiary and Marine Pleistocene; and finally a return to Cretaceous[121].

The UK has a diversity of mountain ranges and flood plains. In England, the southern part of the country is predominantly lowland, with mountainous terrain north-west of the Tees-Exe line (the Lowland-Upland divide across England), which includes the Cumbrian Mountains of the Lake District, the Pennines and limestone hills of the Peak District, Exmoor and Dartmoor[122].

The Geological Conservation Review (GCR) was launched in 1977 in order to identify and describe the most important (nationally and internationally) geological sites in Britain, and to create a suite of descriptions which collectively catalogue and display the full range of the UK's earth heritage features. The full geological chronology from the Cambrian period to the Quaternary is covered in 3,000 sites spanning100 categories (or 'blocks').

There are over 2,000 geological Sites of Special Scientific Interest (SSSIs) in the UK. Across the UK there are also a number of non-statutory geological and geomorphological sites

[120] Natural England (2008) *State of the Natural Environment 2008.* Available online at: http://publications.naturalengland.org.uk/publication/31043?category=118044
[121] Natural England. *England's geology.* Available online at: http://webarchive.nationalarchives.gov.uk/20140605090108/http://www.naturalengland.org.uk/ourwork/conservation/geodiversity/englands/default.aspx
[122] Natural England (2008) *State of the Natural Environment 2008*. Available online at: http://publications.naturalengland.org.uk/publication/31043

designated at a local level, i.e. often known as Local Geological Sites (formerly Regionally Important Geological and Geomorphological Sites (RIGS)).

Land Use and Soils

The UK covers an area of 24,853,200 hectares (248,532 km^2). England comprises the largest land area in the UK, covering an area of 13,293,800 hectares (132,938 km^2). The smallest land area in the UK is Northern Ireland, which covers an area of 1,413,000 hectares (14,130 km^2)[123].

Average population density of the UK in 2017 is 263 people per square kilometre[124].

Table 4.1 shows land cover in the UK as it stood in 2007 and highlights that arable and horticulture and improved grassland are the most common land cover types, constituting 25.5% and 25.3% of total land area in the UK respectively[125].

[123] ONS. *The Countries of the UK*. Available online at: http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/administrative/the-countries-of-the-uk/index.html

[124] ONS (2017) *Overview of the UK population: March 2017*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/articles/overviewoftheukpopulation/mar2017

[125] Countryside Survey (2011) *Final Report for LCM2007*. Available online at: http://nora.nerc.ac.uk/14854/1/LCM2007_Final_Report_-_vCS_Web.pdf

Table 4.1 Estimated Areas of Broad Habitats in the UK in 2007

Land Type	'000 Hectares	% Land Area
Broadleaved, mixed and yew woodland	1,373.3	5.6
Coniferous woodland	1,505.7	6.1
Arable and horticulture	6,300.5	25.5
Improved grassland	6,237.7	25.3
Neutral grassland	1,589	6.4
Calcareous grassland	37.2	0.2
Acid grassland	1,647.1	6.7
Dwarf shrub heath	2,111.8	8.5
Fen, Marsh, Swamp	10.1	0.1
Bog	1,097.2	4.3
Freshwater	324.8	1.3
Montane	488.6	2.0
Inland Rock	131.4	0.5
Built-up Areas and Gardens	1,464.8	6.0
Other land	363.3	1.5
Total	**24,682.5**	**100%**

Source: Countryside Survey, LCM2007.

According to the 2011 UK National Ecosystem Assessment, 6.8% of the UK's land area is classified as urban, the urban landscape accounts for 10.6% of England, 1.9% of Scotland, 3.6% of Northern Ireland and 4.1% of Wales (and encompass some agricultural land). The remainder of the population live in smaller towns and villages, with a very small proportion scattered through the countryside[126].

Within the rural areas, land use varies greatly on a very local basis, but there are clear regional trends. There is a much higher proportion of arable farming in the east than in the west, with most of East Anglia and the area around the Wash almost entirely arable or devoted to other forms of intensive agriculture. To the west, there is much more grassland, although a high proportion of it is improved grassland, particularly in lowland areas; this is often cultivated for fodder or silage as much as for grazing. Upland areas, particularly in the north, the west and Wales, tend to have a high proportion of unimproved land used for extensive rather than intensive grazing, mainly for sheep, and large areas of forestry.

[126] UNEP (2011) *UK National Ecosystem Assessment, Synthesis of Key Findings 2011*. Available online at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx

National Forest Inventory Woodland Area Statistics for Great Britain highlight that the area of woodland in Great Britain at 31 March 2010 is estimated to be 2,982 thousand hectares, around 13.0% of the total land area in Great Britain[127].

The quality of land across the UK varies, with the best and most versatile agricultural land generally situated in the lowland and valley areas of England. Due to the topography and terrain, much of Scotland and Wales is classified as lower grade land. An estimated 21% of all farmland in England is classified as Grade 1 ('Excellent') and 2 ('Very Good') land, with a similar percentage graded as Subgrade 3a ('Good') land. These grades are the best and most versatile land grades as classified under the Agricultural Land Classification System (ALC)[128].

There is estimated to be around 400,000 hectares of contaminated land in the UK (around 1.6% of the total land area)[129]. The UK has a substantial legacy of chemical contaminants in soil. Some contaminants may be present naturally, but more often they occur as a result of human industrial and domestic pollution. Such contamination is typically found in brownfield sites on former industrial land. The majority of such sites are in urban contexts, but a large number are not, particularly those associated with mining or other extractive industries, primary processing of bulk raw materials and power generation.

England

Geology

England's landscape is closely associated with its underlying geology. The topography of England is very varied. Lowland areas are generally found in the East of England. The North West is the most mountainous area with other rugged areas found in the South West and central northern regions. There are a number of upland areas across England, such as the South Downs, Cotswolds, Peak District and North York Moors.

In 2008 Natural England reported that there were 1,214 SSSIs designated for their geodiversity features covering 1,704 Geological Conservation Review (GCR) sites (which identified nationally important features of geological interest). Many SSSIs have more than one GCR feature and some GCR features extend over more than one SSSI, giving a total of 1,735 SSSI-GCR combinations, or 'geo-features'. The proportion of GCRs in favourable/recovering status varied between 76-94% depending on its category of GCR (each category is reported separately)[130].

There are no formal international designations for geodiversity sites equivalent to the SPA and SAC designations for biological features, although the geodiversity of the Dorset and East Devon Coast is recognised through designation as a World Heritage Site.

England contains two Global Geoparks: the English Riviera in Devon and the North Pennines AONB. These are areas considered by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) to be of international importance for geological heritage that should be safeguarded and sustainably managed and include strong local involvement. Two further

[127] Forestry Commission (2011) *National Forest Inventory Statistics for Great Britain*. Available online at: https://www.forestry.gov.uk/pdf/NFI_GB_woodland_area_stats_2010_FINAL.pdf/$FILE/NFI_GB_woodland_area_stats_2010_FINAL.pdf
[128] Natural England (2012) *Agricultural Land Classification: protecting the best and most versatile agricultural land, TIN049*. Available online at: http://publications.naturalengland.org.uk/file/4424325
[129] Department for International Trade (2015) *Land remediation: Bringing brownfield sites back to use*. Available online at: https://www.gov.uk/government/publications/land-remediation-bringing-brownfield-sites-back-to-use/land-remediation-bringing-brownfield-sites-back-to-use
[130] Natural England (2008) *State of the Natural Environment, Chapter 2: Landscapes*. Available online at: http://publications.naturalengland.org.uk/publication/31043

areas in England (Abberley and Malvern Hills and the Cotswold Hills) identify themselves as national Geoparks[131].

Land Use and Soils

As of 2016, the average population density of England was estimated to be 417 people per square kilometre.

Table 4.2 shows land cover in England as it stood in 2007 and highlights arable and horticulture and improved grassland as the most common land use covers (covering 40.5% and 27.1% of total land in England respectively)[132].

Table 4.2 Land Cover in England in 2007

England Land Cover 2007	'000 ha	% Area
Broadleaved, Mixed and Yew Woodland	930	7.1
Coniferous Woodland	303.3	2.3
Arable and Horticulture	5,332.9	40.5
Improved Grassland	3,568.4	27.1
Neutral Grassland	611	4.6
Calcareous Grassland	35.9	0.3
Acid Grassland & Bracken	317.1	2.4
Dwarf Shrub Heath	361.0	2.6
Fen, Marsh and Swamp	6.8	0.1
Bog	196.5	1.5
Freshwater	79.8	0.6
Montane	36.6	0.3
Inland rock	42.3	0.3
Built-up Areas and Gardens	1,169	8.9
Supra-littoral rock	1.0	-
Supra-littoral sediment	18.4	0.1
Littoral rock	11.2	0.1

[131] UNESCO (2017) *Properties inscribed on the World Heritage List for the United Kingdom*. Available online at: http://whc.unesco.org/en/statesparties/gb

[132] Countryside Survey (2011) *Final Report for LCM2007*. Available online at: http://nora.nerc.ac.uk/14854/1/LCM2007_Final_Report_-_vCS_Web.pdf

England Land Cover 2007	'000 ha	% Area
Littoral sediment	161.7	1.2
TOTAL	**13,182.9**	**100**

Source: Countryside Survey, LCM2007.

The majority of land in England (around 70%) is in agricultural use. A further 9% is used for woodland and forestry. Whilst urban areas account for around 10% of the total area, only a very small proportion of the land (1.1%) is occupied by domestic buildings (e.g. houses), with domestic gardens accounting for almost half of the 'developed area' (over 4% of the national land area). Roads account for around 2% and rail 0.13% of the total[133]. Of the agricultural land, approximately 42% is classed as best and most versatile land grades ('good' or better).

A total of 511 sites had been reported to the Environment Agency as 'contaminated land' at April 2016, however this is likely to be an underestimate due to a low response rate from local councils. Less than 2% of the land area of England is estimated to have been affected by industrial activities of a type that could have caused contamination[134].

Scotland

Geology

As a broad overview, the following rock types exist in a progression from north east to south west Scotland (predominant rock types): Pre-Cambrian (the Highlands); Carboniferous (Midland Valley area); and Ordovician and Silurian (Southern Uplands). Topographically, Scotland is divided into three main areas; the Highland region in the north, which includes the Cairngorm and Grampian mountain ranges; the Central Lowlands, which includes the major cities of Edinburgh and Glasgow; and the Southern Uplands, a pastoral upland area north of the English border.

As of 2012 there were 895 GCR sites in Scotland, of which 77% were protected by SSSI status[135]. Scotland has two Global Geoparks: North West Highlands Geopark and Shetland Geopark, in addition to Lochaber Geopark (which is currently being considered by UNESCO for global status). These three Geoparks cover approximately 10% of Scotland's land area[136].

Land Use and Soils

The average population density of Scotland is 69 people per square kilometre. **Table 4.3** shows land cover in Scotland as it stood in 2007 and highlights Dwarf Shrub Heath as the most common land use cover (covering 19.6% of total land in Scotland).

[133] UNEP (2011) *UK National Ecosystem Assessment, Chapters 10 (Urban) and 17 (England*). Available online at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx
[134] Environment Agency (2016) *Dealing with contaminated land in England*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/513158/State_of_contaminated_land_report.pdf
[135] Scottish Natural Heritage (2012) *Geological conservation review (GCR) sites*. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/safeguarding-geodiversity/protecting/geological-conservation/
[136] Scottish Natural Heritage (2016) *Protecting Scotland's nature: Geopark*. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/international-designations/geoparks/

Table 4.3 Land Cover in Scotland in 2007

Scotland Land Cover 2007	'000 ha	% Area
Broadleaved, Mixed and Yew Woodland	264.2	3.3
Coniferous Woodland	993.8	12.5
Arable and Horticulture	704.1	8.8
Improved Grassland	1,117.8	14.0
Neutral Grassland	575.8	7.20
Calcareous Grassland	1.2	0.03
Acid Grassland & Bracken	1,024.0	12.80
Dwarf Shrub Heath	1,566.0	19.60
Fen, Marsh and Swamp	2.6	0.07
Bog	768.9	9.60
Freshwater	170.3	2.10
Montane	452.0	5.70
Inland Rock	70.5	0.90
Built-up Areas and Gardens	142.1	1.80
Supra-littoral rock	6.0	0.10
Supra-littoral sediment	22.0	0.30
Littoral rock	35.1	0.40
Littoral sediment	60.4	0.80
TOTAL	**7,976.8**	**100**

Source: Countryside Survey 2007.

Agricultural uses of land in Scotland cover 75% of the land area, and only 2.4% of the land is urban[137].

Scotland has a large variety of soils reflecting its geological and climatic diversity. Scotland's soil is predominantly carbon rich, with podzols, peat soils and gleys accounting for more than two-thirds. These soils are found throughout Scotland with the exception of the Central Valley, which is dominated by mineral soils. Soils in the north and west are more acidic on the whole and rich in organic matter. Scotland contains a much higher proportion of organic soils than the rest of the UK[138].

[137] UNEP (2011) *UK National Ecosystem Assessment, Chapter 19 (Scotland).* Available online at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx

[138] The Scottish Government (2009) *Scottish Soil Framework*. Available online at:

The quality of land is highly variable with much of Scotland classified as Less Favoured Areas (suited only for improved grassland and rough grazing). Prime agricultural land (suitable for a wide range of crops) make up 8% of the total land area according to the Land Capability for Agriculture Classification Scheme, which is distributed predominantly along the eastern coasts, and the Firths of Forth and Tay[139].

In 2005, there was estimated to be around 82,034 hectares of land affected by industrial activity in Scotland that may be contaminated. A total of 13 sites (equivalent to 53 hectares) had been determined as 'contaminated land' under the Environmental Protection Act by the end of 2008[140].

Wales

Geology

The bedrock geology of Wales is extremely varied and comprises sandstone, limestone and igneous rock. As a broad overview, the following rock types exist in a progression from North West to South East Wales (predominant rock types): Ordovician; Silurian; Devonian; and Carboniferous Peat (covers 3% to 4% of Wales and is predominantly acid blanket peat). There are small areas of raised bog and fen peat scattered in lowland areas.

Coal and metal mining has been very important to Wales historically. The South Wales Coalfield stretches across a large part of South Wales and is still mined to some extent, although less than previously (and from opencast or drift mines rather than deep mines). Lead and silver were once produced from mines in mid-Wales, from a series of mines inland from Aberystwyth. Copper, meanwhile, was mined in Snowdonia and at Parys Mountain on Anglesey, whilst gold was exploited around Dolgellau and Pumpsaint. A number of other metals were produced including zinc, arsenic, antimony and manganese. The geodiversity of Wales has led to the forming of landscapes and environmental settings that have strong cultural service value. For example, the mountains of Snowdonia attract tourists to Wales whilst coal mining has helped to define the cultural identity of the South Wales Valleys.

Within Wales, there are approximately 450 SSSIs designated for geology and earth science features. The Joint Nature Conservation Committee (JNCC) has reported the first six years of Common Standards Monitoring for Geological SSSIs in the UK but limited information is available for SSSIs in Wales in this respect. There are also 443 Geological Conservation Review (GCR) sites[141] and there are two Global Geoparks located in Wales (Fforest Fawr and Ynys Môn)[142].

Land Use and Soils

The average population density of Wales is 149 people per square kilometre.

Table 4.4 shows land cover in Wales as it stood in 2007 and highlights improved grassland as the most common land use cover (covering 40.0% of total land in Wales).

http://www.gov.scot/Resource/Doc/273170/0081576.pdf

[139] The James Hutton Institute (2011) *Land Capability for Agriculture in Scotland*. Available online at: http://www.hutton.ac.uk/sites/default/files/files/soils/lca_leaflet_hutton.pdf

[140] SEPA (2009) *Dealing with land contamination in Scotland: A review of progress 2000-2008*. Available online at: https://www.sepa.org.uk/media/28314/dealing-with-land-contamination-in-scotland.pdf

[141] JNCC (2015) *Geological Conservation Review*. Available online at: http://jncc.defra.gov.uk/page-2947

[142] UNESCO (2017) *Global Geoparks*. Available online at: http://www.unesco.org.uk/designation/geoparks/

Table 4.4 Land Cover in Wales in 2007

Wales Land Cover 2007	'000 ha	% Area
Broadleaved, Mixed and Yew Woodland	125.1	5.90
Coniferous Woodland	143.1	6.80
Arable and Horticulture	176.9	8.40
Improved Grassland	842.2	40.00
Neutral Grassland	227.1	10.80
Calcareous Grassland	0.0	0.00
Acid Grassland & Bracken	284.5	13.50
Dwarf Shrub Heath	112.2	5.30
Fen, Marsh and Swamp	6.0	0.05
Bog	41.5	2.00
Freshwater	11.4	0.50
Montane	1.7	0.10
Inland Rock	8.8	0.40
Built-up Areas and Gardens	89.3	4.30
Supra-littoral rock	0.8	0.04
Supra-littoral sediment	6.3	0.40
Littoral rock	3.0	0.10
Littoral sediment	30.2	1.40
TOTAL	2,110.1	100.00

Source: Countryside Survey, LCM2007.

Land use in Wales is dominated by farmland and grasslands, urban land accounts for 5% of the land area, and woodlands 14%. These characteristics reflect the climate, relief and soil type of Wales[143].

The area designated as 'Best and Most Versatile' agricultural land accounts for approximately 7% of total land in Wales, which includes land of 'good to moderate' quality and above[144].

[143] UNEP (2011) *UK National Ecosystem Assessment, Chapter 20 (Wales)*. Available online at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx
[144] Welsh Government (2016) *Agricultural Land Classification*. Available online at: http://gov.wales/topics/environmentcountryside/farmingandcountryside/agricultural-land-classification/?lang=en

A total of 10,130 potentially contaminated sites had been brought to the attention of local authorities in Wales, with 175 determined as 'contaminated land' in Wales by the end of 2013. The most common contaminants were Benzo(a)pyrene, lead and arsenic, all of which were identified at over 60% of determined contaminated land sites[145].

Summary of Existing Problems Relevant to the Geological Disposal NPS

The following existing problems for land use, geology and soils have been identified.

Geology

- There is a need to protect, maintain and enhance geomorphological functions and services.
- Mining activities have left a legacy of localised hazards in some parts of the UK such as landslips, subsidence, contamination of ground and surface water sources from metals such as tin, copper and arsenic, and radon gas and flooding.

Land Use and Soils

- Of UK land, 7% is currently classified as 'urban.' Development pressure remains a constant factor in parts of the country, and it is not expected that previously-developed land will be able to fully deliver the UK's future needs. This will continue to place development pressures in rural areas and the urban fringe.
- Some 1.6% of land in the UK is contaminated from industrial activity, although this is progressively being cleaned up as sites are redeveloped. Whilst contamination is remediated during redevelopment, the process can be expensive.
- Disturbance of contaminated sites carries the risk of pollution pathways being created or re-opened for any existing ground contamination.
- There is currently increasing pressure on rural and agricultural land from developers as urban areas expand. Future population growth leading to an increase in the need for housing and related urban development infrastructure will put more pressure on protected land including important geological sites.
- Soils in England, Scotland and Wales continue to be affected by human actions including intensive agriculture, historic levels of industrial pollution and urban development, making them vulnerable to erosion (by wind and water), compaction and loss of organic matter[146]. Effects include:
    - loss of organic matter – soil organic matter underpins many soil functions. It is particularly important as a carbon store and thus has implications for climate change. The most recent evidence suggests relatively low rates of change in topsoil soil organic matter concentration; however, there is still uncertainty about the status and change in the soil organic matter stock;

[145] Natural Resources Wales (2016) *The State of Contaminated Land in Wales*. Available online at: https://naturalresources.wales/media/677708/nrw26759-contaminated-land-in-wales-pdf_english-1.pdf
[146] Natural Scotland (2011) *The State of Scotland's Soil*. Available online at:
Error! Hyperlink reference not valid.

- sealing – there is no systematic data collection to capture the extent and the quality of land being sealed. It is essential that the value of soil functions is taken into account during development planning;
- contamination – data on the extent and nature of soil contamination is limited. There is some evidence that some contaminant inputs and their impacts are reducing, for example from atmospheric acid deposition. However, many other potential soil contaminants such as organic chemicals are not routinely measured;
- change in soil biodiversity – soil biodiversity is essential to most ecosystem services;
- erosion and landslides – soil erosion is one of the more visible of the threats to soil. Impacts include loss of soil carbon, loss of fertility and off-site effects such as impacts on the water environment. Landslides, although potentially life threatening, remain rare;
- compaction – the processes associated with soil compaction are broadly understood, but there is no systematic assessment of the extent and wider implications of soil compaction.

- As the climate (including temperature and rainfall patterns) changes in the future, it is likely that soils have the potential to be further affected, as a result of increased seasonal aridity and wetness and variations in temperature[147]. Climate change and changes in land use and land management are the most significant threats to Scottish soils[148]. The effect of industry, agricultural practices, forestry and climate change upon soils, particularly carbon rich peat soils, is also a key issue. Key pollutants include chemicals, oil or waste. Organic waste, including sewage sludge, is one of the main sources of heavy metal contamination of soils from humans.

Likely Evolution of the Baseline

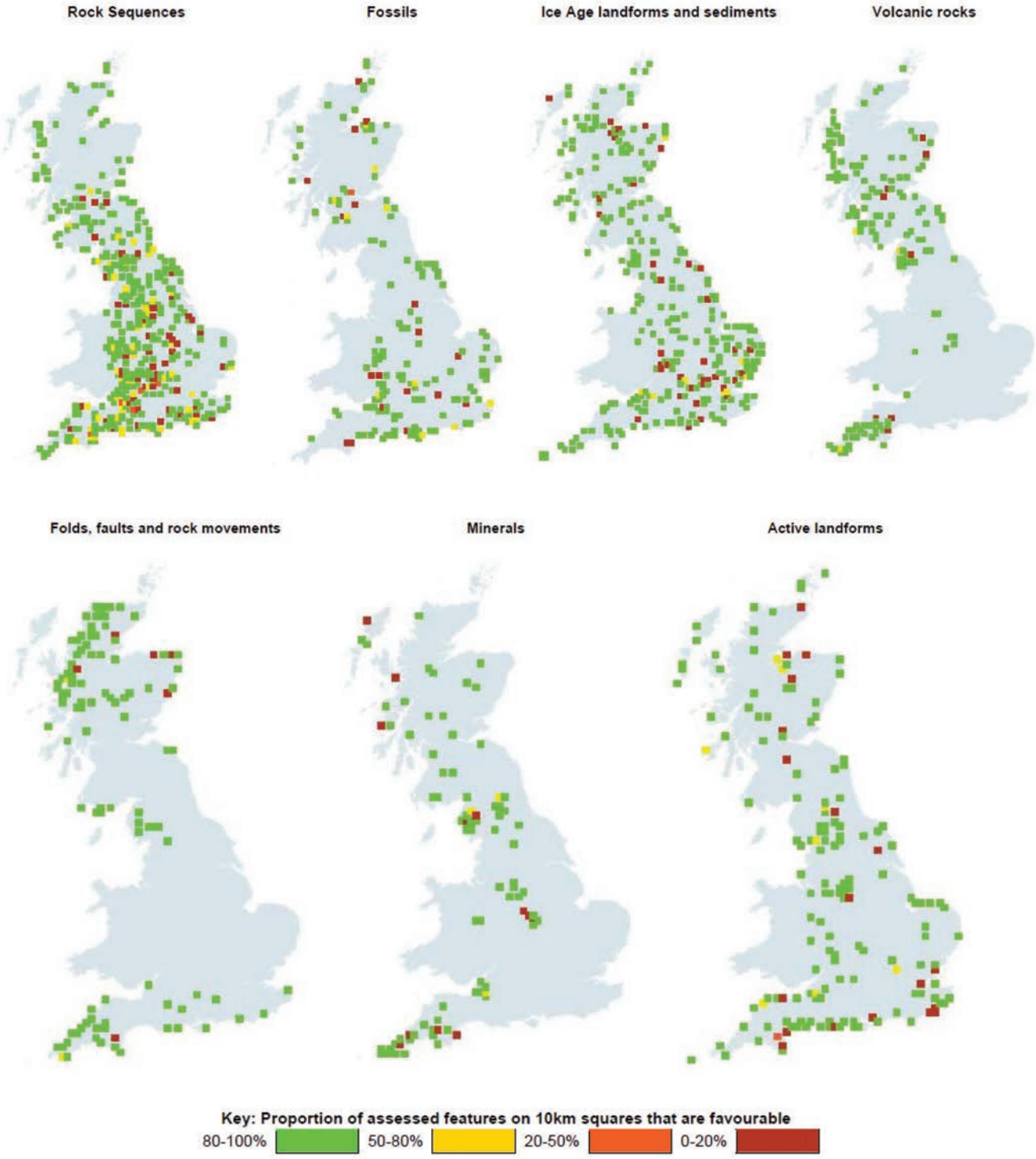
UK

Geology

As part of the JNCC Common Standards Monitoring for designated sites, the features for which certain sites are designated were assessed to determine site condition. For geological sites, the principal designations are GCRs and SSSIs, many of which occupy the same or part of the same area of land. Site attribute condition was compared with its target value, the outcome of which resulted in a site being classified as favourable, unfavourable, unfavourable-recovering, or destroyed (in whole or in part). The overall results of the survey for broad geological features are indicated in **Table 4.5**, and the spatial distribution of sites and their condition in shown in **Figure 4.1**.

[147] UK Committee on Climate Change (2017) UK Climate Change Risk Assessment. Available online at: https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/
[148] Natural Scotland (2016) *Soils*. Available online at: http://www.environment.scotland.gov.uk/get-informed/land/soils/

Figure 4.1 Condition of SSSI Features (Where Unfavourable-Recovering is Counted as Unfavourable)



Source: Williams, JM (ed.) (2006). Common Standards Monitoring for Designated Sites: First Six Year Report. Peterborough, JNCC. Available online at: http://jncc.defra.gov.uk/pdf/CSM_06geology.pdf

Table 4.5 Condition of Geological Features

Category	No. of Assessments	% Favourable and Unfavourable-Recovering	% Destroyed (whole or part)
Rock sequences	859	84.5	1
Fossils	274	87.6	1
Ice Age landforms & sediments	410	90.2	1
Volcanic rocks	215	95.3	-
Folds, faults & rock movements	139	93.5	1
Minerals	120	85.8	8
Active landforms	225	89.3	1
Total	**2,242**	**88.1**	**1.3**

Source: Williams, JM (ed.) (2006). Common Standards Monitoring for Designated Sites: First Six Year Report. Peterborough, JNCC. Available online at: http://jncc.defra.gov.uk/pdf/CSM_06geology.pdf

The main findings of arising from the results presented above are summarised below by category:

- Rock Sequences: The rock sequences category has the largest number of sites in any of the broad categories studied, with stratigraphic sequences representing the most abundant feature in this assessment (ca. 80%). A high number of sites (ca. 83%) are in favourable condition, and those which are not are principally so due to the feature being obscured. Management agreements are in place for many sites, which include measures to keep features exposed.
- Fossils: Williams (2006) accounts for ca. 75% of sites which have fossils indicated as a notified feature, 87% of which are in a favourable condition. Like many geological sites, many are considered unfavourable because features are obscured rather than damage inflicted as a result of fossil collectors.
- Ice Age Landforms and Sediments: About 75% of Quaternary features, which includes glacial landforms and sediments, have been accounted for in the JNCC Common Standard Monitoring assessment, 88% of which are reported as being in favourable condition. 1% of features are reporting as having being destroyed in whole or in part, with the remainder being unfavourable or recovering, mostly where sites are obscured.
- Volcanic Rocks: Of the 70% coverage of volcanic (igneous) rock sites assessed, 95% were regarded as favourable. Most igneous areas are robust and less likely to be affected by activities which may be damaging to soft rock or sedimentary landscapes. The unfavourable condition of most sites results from being obscured, probably by vegetation cover or scree.
- Folds, Faults and Rock Movements: Only 40% of sites in this category were accounted for, and 94% were in favourable condition. Like volcanic rock areas, the robust nature of the rocks and features in this category makes them less susceptible to damage than soft-rock, sedimentary and more dynamic landscapes.
- Minerals: Just over 60% of sites are accounted for in the assessment, of which 86% are regarded as in favourable condition. There is a relatively large amount of partially or wholly destroyed sites (7.5%) compared with the other broad geological categories. Apart from being obscured, minerals have been the subject of anthropogenic exploitation and at some sites most or all of the features have been removed.
- Active Landforms: Just over 60% of active landforms (including caves, karst features, fluvial and coastal geomorphology) have been accounted for in the assessment, 86% of which are in favourable condition. The data collected for this category is too sparse to detect any trends in the reasons for the condition of sites. Active landforms are often large and their dynamic, complex nature makes them particularly difficult to monitor.

The increase in public and policy awareness regarding geological SSSI sites and Geoparks may lead to an increase in the number of sites protected and managed. As quarries come to the end of their working lives there is potential for their identification and conservation as geologically important sites.

Land Use and Soils

The estimated broad habitat type in the UK (Great Britain) and how it has changed from 1984 to 2007 was calculated by the Office of National Statistics[149] and is shown in **Table 4.6**. It shows that the area of land cover under arable and horticulture has decreased by 9.1% between 1998 and 2007. The area of grassland land cover has generally increased with improved grassland increasing by 5.7%. Built-up areas and gardens have increased by 3.4% between 1998 and 2007.

Table 4.6 Estimated Area ('000 ha) of Broad Habitats in the UK (Great Britain) in 1984, 1990, 1998 and 2007

Land Type	1984	1990	1998	2007	% Change between 1998 and 2007
Broadleaved, mixed and yew woodland	1317	1343	1328	1406	5.9
Coniferous woodland	1243	1239	1386	1319	-4.8
Linear features	491	581	511	496	-2.9
Arable and horticulture	5283	5024	5067	4608	-9.1
Improved grassland	5903	4619	4251	4494	5.7
Neutral grassland	467	1669	2007	2176	8.4
Calcareous grassland	75	78	61	57	-6.6
Acid grassland	1476	1821	1503	1589	5.7
Bracken	439	272	315	260	-17.5
Dwarf shrub heath	1388	1436	1299	1343	3.4
Fen, Marsh, Swamp	428	427	426	392	-8.0
Bog	2303	2050	2222	2232	0.5
Standing open waters	284	200	196	204	4.1
Rivers and streams	70	70	65	58	-10.8
Montane	41	n/a	41	42	2.4
Inland rock	38	76	111	84	-24.3
Built-up areas and gardens	1268	1266	1279	1323	3.4
Other land	n/a	57	107	113	n/a

[149] ONS (2011) *Land cover account, Great Britain*. Available online at: http://www.ons.gov.uk/ons/rel/environmental/environmental-accounts/2011/rftlandcover.xls

Land Type	1984	1990	1998	2007	% Change between 1998 and 2007
Unsurveyed land	n/a	522	522	522	n/a
Total	**22,514**	**22,632**	**22,601**	**22,627**	

Source: Countryside Survey 2007. Note: Standing open waters and rivers and streams broad habitats are calculated using a different statistical model to the other broad habitats. The land in urban areas from within Great Britain was excluded from the estimation of broad habitats. The totals are therefore not equal to the sum of the column.

It is not known whether the decrease in arable and increase in improved grassland is likely to continue at the same rate in the future although it does seem likely that the extent of built up areas will continue to increase as some development will inevitably take place on greenfield land.

The total area of agricultural land across the UK has declined slightly over the last 30 years from 18,753 thousand hectares in 1984 to 18,428 thousand hectares in 2015 (a reduction of 1.7%)[150]. This area includes arable and horticultural crops, uncropped arable land, common rough grazing, temporary and permanent grassland and land used for outdoor pigs.

The clearest trend in land use change in the UK over the past quarter of a century has been the conversion of land from agriculture to forestry and woodland. Forestry Commission estimates of the area of forest and woodland cover in the UK imply an average annual net increase of 28,000 hectares from 1980 to 2016, equivalent to 0.11% increase in total UK land cover per year. This follows on from a slower but steady increase in woodland cover from the early 1900s onwards, and there has overall been a doubling of the area of UK woodland since World War II to reach 3.16 million hectares in 2016[151].

New planting has predominantly responded to subsidy and has involved the expansion of small broadleaved woodlands within agricultural holdings. The average annual increase in woodland on farms (14,500 hectares per annum) accounts for more than half of the net increase in the wooded area as a whole. The area of woodland within agricultural holdings has thus more than doubled since the early 1980s[152].

A number of threats to the UK soil resource have been recognised in England, Scotland and Wales including:

- loss of soil organic matter and erosion;
- climate change;
- loss of soil biodiversity;
- structural degradation and compaction;
- contamination;

[150] Defra (2016) *Agriculture in the UK: Datasets, Chapter 2*. Available online at: https://www.gov.uk/government/statistical-data-sets/agriculture-in-the-united-kingdom
[151] Forestry Commission (2016) *Forestry Statistics 2016: Chapter 1*. Available online at: http://www.forestry.gov.uk/pdf/Ch1_Woodland_FS2016.pdf/$FILE/Ch1_Woodland_FS2016.pdf
[152] Bibby, P. (2009) *Land Use Change in Britain. Land Use Policy, 26S, S2–S13.*

- loss of soil to development (e.g. soil sealing), including urbanisation and agriculture; and
- threat to soil as a cultural resource (e.g. archaeological protection and UK environmental records).

UK soils store around 10 billion tonnes of carbon[153]. A study by the National Soil Inventory (NSI) found that between 1978 and 2003 there was a loss in soil organic carbon of 0.6% per year for all soil types, though with higher losses (2% per year) in those which are particularly organic rich[154]. However, between 1990 and 2014, the UK has gone from being a net source of Land Use, Land Use Change and Forestry (LULUCF) emissions to a net sink driven by land converted to cropland and forest land, with an increasing uptake of CO_2 by trees as they reach maturity, in line with the historical planting pattern[155].

Future projections of LULUCF GHG emissions and removals do not include a climate component because of fundamental uncertainties, even with regard to present-day conditions. Enhanced storage of carbon due to a longer growing season and CO_2 fertilisation[156] is likely to be countered by a loss of carbon from enhanced soil respiration due to higher temperatures. At present, it is difficult to evaluate which will be the dominant process and it will also depend on changes in soil water regimes. Nevertheless, in currently vulnerable areas (e.g. unvegetated or degraded peat), higher temperatures and the likelihood of drier summers, particularly in the eastern side of the UK, would be likely to substantially increase the loss of carbon stocks. Hence, the role of land management in enhancing soil resilience, by maintaining peat-forming vegetation cover for example, or limiting tillage during cultivation, will be important for both climate adaptation and mitigation objectives[157].

Compaction may result from a number of activities including intensive mechanised agriculture, poor timing of cultivation, over-stocking and overworking of land. The result is a reduced plant yield, habitat loss for larger fauna, NO_2 losses, reduced water holding and soil infiltration capacity and an increased risk of flooding and erosion. The principal causes of accelerated erosion (i.e. that which exceeds background levels) in England, Wales and Scotland are:

- intensive cultivation - particularly where compacted by machinery and left open to rain;
- trampling by animals;
- poor forestry practice (e.g. during road construction and harvesting); and
- run-off from urban land surfaces.

[153] Defra (2009) *Safeguarding our Soils – A Strategy for England*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69261/pb13297-soil-strategy-090910.pdf
[154] Bellamy PH, Loveland PJ, Bradley RI, Lark RM and Kirk GJD (2005) *Carbon Losses from all Soils across England and Wales 1978-2003. Nature 437: 245-248*. Available online at: https://www.researchgate.net/publication/7612941_Carbon_losses_from_all_soils_across_England_and_Wales_1978-2003f
[155] DECC (2016) *2014 UK Greenhouse Gas Emissions, Final Figures*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/496942/2014_Final_Emissions_Statistics_Release.pdf
[156] The CO_2 fertilisation effect is the principle that the increase of carbon dioxide in the atmosphere increases the rate of photosynthesis in plants.
[157] UK Committee on Climate Change (2017) *UK Climate Change Risk Assessment*. Available online at: https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/

Other causes include wind erosion, tillage losses and soil co-extracted with root vegetables[158]. The rate of soil erosion due to agriculture is thought to have remained relatively stable across the period 1969 to 2010[159].

Soil chemical and biological processes are controlled by a complex set of factors, but most importantly by the balance between soil temperature and soil moisture. Temperature is a key factor that can control many terrestrial biogeochemical processes. Soils processes, properties and functions are therefore all sensitive to changes in climatic conditions.

Future changes in temperature and precipitation could potentially have considerable impacts on soils and their biodiversity. Rising atmospheric concentrations of CO_2, are also likely to influence soils indirectly via changes in plant growth. There is a high degree of uncertainty about how climate change will affect soils in the UK due to limitations on the current evidence and the difficulties of distinguishing the role of climate from other factors. Nevertheless, the majority of climate projections imply a trend towards reductions in soil moisture, most notably in the eastern districts of the UK, due to an increased frequency of warmer, drier summers. The consequent changes in soil water regimes will be highly dependent on soil type and, in combination with elevated temperatures and CO_2 levels, will have an impact on rates of soil physical, biological and chemical processes, and hence on soil function and ecosystem services[160].

Soil biodiversity is an emerging field of soil science and there is a low level of understanding and few relevant datasets, and it is not known what effects pollutants including metals and pesticides have on soil organisms important for maintaining soil quality[161]. Organisms include bacteria, fungi and invertebrates, 100 of which are regarded as BAP species, and like many other facets of the UK's natural environment, soil habitats are host to introduced species such as the predatory New Zealand flatworm[162].

Contaminated land may be the result of a legacy of old industrial practices or more recent incidents and is regarded as 'contaminated' in legislation (Part 2A of the Environmental Protection Act 1990) where there is a threat to the natural environment or public health. The area of contaminated land in the UK cannot be reliably estimated, though the Environment Agency estimates that ~325,000 sites covering 300,000 hectares (~2% of the area of England and Wales) are affected[163]. The most common pollutants at sites identified by the Environment Agency were heavy metals and inorganic/organic compounds. Other contamination results from pollutant deposition and direct application, leading to acidification and nutrient enrichment.

[158] Quine TA, Van Oost K, Walling DE and Owens PN. (2006) *Development and Application of GIS-Based Models to Estimate National Rates of Soil Erosion by Tillage, Wind and Root Crop Harvest*. University of Exeter Report to Defra, Project SP08007, University of Exeter, UK, 59pp. Available online at: http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CCIQFjAA&url=http%3A%2F%2Frandd.defra.gov.uk%2FDocument.aspx%3FDocument%3DSP08007_6584_FRA.pdf&ei=mBdnVdaOC4X2UvaVgPgK&usg=AFQjCNEcGiVgzMhyX0jjAa1ghaPkRmpA-Q&bvm=bv.93990622,d.d24

[159] Cranfield University (2015) *Research to develop the evidence base on soil erosion and water use in agriculture: Final Technical Report*. Available online at: https://www.theccc.org.uk/wp-content/uploads/2015/06/Cranfield-University-for-the-ASC.pdf

[160] UK Committee on Climate Change (2017) *UK Climate Change Risk Assessment*. Available online at: https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/

[161] Natural England (2008) *State of the Natural Environment*. Available online at: http://publications.naturalengland.org.uk/publication/31043

[162] Environment Agency (2004) *The state of soils in England and Wales*. Available online at: http://www.adlib.ac.uk/resources/000/030/045/stateofsoils_775492.pdf

[163] Environment Agency (2009) Dealing with contaminated land in England and Wales. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/313964/geho0109bpha-e-e.pdf

The soil of the UK has gradually built up since the end of the last Ice Age ~10,000 years ago during the current Holocene warm period, and even before in the case of palaeosols. Soils provide protection for a great deal of the UK's archaeological resource which remains covered, protecting it from redistribution, erosion, and in the case of peat, may provide exceptional preservational contexts. Undisturbed peatlands also preserve the environmental record of areas all over the UK pertaining to the Holocene which can be reconstructed using palaeo-archaeological methods (e.g. plant macrofossil, microfossil, entomological and sedimentary analyses). In many cases the soils themselves are a cultural construct such as the thickened soils of St Kilda[164,165], and the rig-and-furrow formations which are the most abundant archaeological feature in Scotland[166].

Land use including agriculture and building work have the potential to disturb archaeological contexts, which if not appropriately studied, could be damaged. Since the middle of the last century in England, 23,500 ancient monuments have been destroyed, with a total 10% destroyed and 30% damaged by agricultural practices. Around 3,000 Scheduled Monuments are actively ploughed, and a third of all sites are on ploughed land, with 2% at high risk. In Wales, 15% of Scheduled Monuments have deteriorated due to natural, agricultural and other causes[167]. In Scotland, there is a lack of monitoring with regard to issues relating to the preservation of archaeological features, and indeed the extent and distribution of cultural soils. In addition, there is a general lack of data on changes in soil condition which may influence preservation conditions.

As there are now more stringent statutory controls on land contamination and remediation, increased areas of historic contamination are being remediated and fewer areas are being left in a contaminated state following decommissioning of commercial and industrial sites.

There are a number of European directives that are being implemented that may influence the way in which land contamination is managed in the future (i.e. the Environmental Liabilities, Water, Groundwater and the Waste Framework Directives). The implementation of these regimes into UK legislation is likely to affect how contaminated land is dealt with.

England

Geology

Natural England[168] has identified the following key threats to geology (which are also equally applicable to Scotland and Wales):

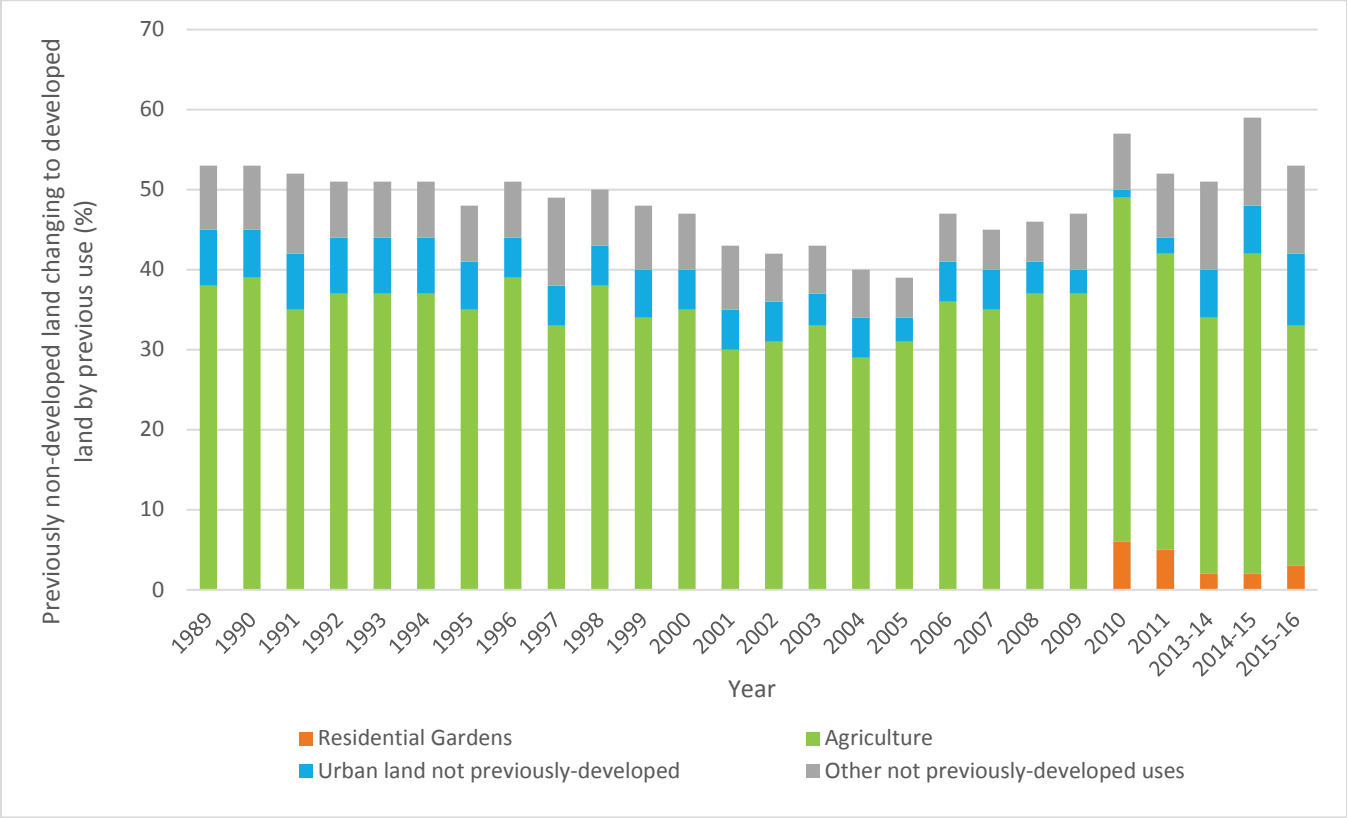
- inappropriate development;
- natural degradation;
- irresponsible specimen collecting; and
- irresponsible recreational activities.

[164] Meharg AA, Deacon C, Edwards KJ, Donaldson M, Davidson DA, Spring C, Schrimshaw C, Feldmann J, Raab A, Ellam R (2005) *Ancient Manuring Practices Pollutes Arable Soil at the St Kilda World Heritage Site, Scottish North Atlantic*. Chemosphere 64: 1818-1828
[165] Donaldson MP, Edwards KJ, Meharg AA, Deacon C and Davidson D (2009) *Land Use History of Village Bay, Hirta, St Kilda World Heritage Site: A Palynological Investigation of Plaggen Soils*. Review of Palaeobotany and Palynology 153: 46-61
[166] Halliday S (2003) *Rig-and-furrow in Scotland*. In: Govan S (ed.) Medieval or Later Rural Settlement in Scotland: 10 years on. Historic Scotland, pp.69-81
[167] Environment Agency (2004) *The state of soils in England and Wales*. Available online at: http://www.adlib.ac.uk/resources/000/030/045/stateofsoils_775492.pdf
[168] Natural England. *What are the threats to geology?* Available online at: http://webarchive.nationalarchives.gov.uk/20140605090108/http://www.naturalengland.org.uk/ourwork/conservation/geodiversity/threats/default.aspx

Land Use and Soils

Figure 4.2 shows the origin and proportion of non-previously developed land lost to development for each year from 1995 to 2015/16 for England. There was a general decrease in the proportion of undeveloped land lost to development from the 1990s to mid-2000s, although the proportion has gradually risen over the last 10 years (with a corresponding decrease in previously developed land being used). Overall, the amount of undeveloped soil lost to development decreased from 12,700 hectares in 1990 to 2,180 hectares in 2011, and has since risen substantially to 15,400 hectares in 2015/16.

Figure 4.2 Soils Lost to Development (England)



Source: DCLG (2017) Live tables on land use change statistics: Land use change statistics - live tables 2015 to 2016. Note data gap from 2011 to 2013/14.

In 2010, there was an estimated 68,910 hectares of previously developed land in England, up 11% from 61,920 hectares in 2009. An estimated 37,940 hectares of previously developed land were vacant or derelict, 55% of the total. Of the 68,910 hectares identified, 27% was currently in use with permission or allocated for redevelopment with a further 18% currently in use with known potential for redevelopment. The remaining 55% was vacant or derelict – 25% consisted of derelict land or building, 23% consisted of previously developed vacant land and 7% consisted of vacant buildings[169].

[169] Homes and Communities Agency (2014) *National Land Use Database PDL 2010 Summary Headline Report*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/366838/NLUD_2010_Summary_Headline_Report.doc

Of all land developed in 2015/16, 16% was for residential uses, 2% for minerals and landfill, 20% for industry and commerce, 13% for transport and utilities, none for defence, and the remaining 49% for other developed uses including community services and vacant land[170].

There have also been changes to land use related to broad habitat types. Between 1998 and 2007 in England there was a significant increase in the area of Broadleaved Woodland (5.8%), Neutral Grassland (12.6%), Dwarf Shrub Heath (15.1%) and Standing Open Water and Canals (5.3%). The increase in the area of Dwarf Shrub Heath between 1998 and 2007 followed a decrease in area between 1990 and 1998. The increase in the area of Standing Open Water and Canals recorded in England between 1998 and 2007 continued the increases recorded by Countryside Survey since 1990. On the other hand, there was a significant decrease in the area of Arable and Horticulture Broad Habitat (8.8%) in England across the same period. No statistical change in extent was detected in the Coniferous Woodland, Improved Grassland, Bracken, Bog, Fen, Marsh and Swamp and Calcareous Grassland Broad Habitats in England between 1998 and 2007[171].

The loss of organic matter from soils influences its structure and is linked to erosion and soil compaction, reduced agricultural productivity and soil biodiversity. Since 1980 there has been an estimated average loss in organic matter in England and Wales of:

- 15% in arable soils and rotational grass soils;
- 16% in soils under permanently managed grassland; and
- 23% in agriculturally managed soils and semi-natural land[172].

17% of soils in England and Wales show signs of erosion which leads to a reduction in water retention and filtering, and the mobilisation of sediment (which may contain pesticides, nutrients and metals) to watercourses or floodplains[173].

In the 2012 Farm Practices Survey for England[174], 20% of farmers stated that they had experienced soil compaction throughout the soil profile. For the 12 months leading up to August 2012, the Farm Practices Survey 2012 indicated that the most common actions taken to reduce compaction were removing compaction from headlands after harvest, enhancing drainage, using low pressure set-ups and crop rotation.

Key objectives and targets within the Soil Strategy for England (Safeguarding Our Soils) include:

- to undertake further research in areas including best practices to protect and enhance levels of soil organic matter, contribution of soil management to flood mitigation and best practices to prevent and remediate soil degradation;
- to significantly reduce the rate of loss of stored soil carbon by 2020;

[170] DCLG (2017) *Live tables on land use change statistics: Land use change statistics - live tables 2015 to 2016*. Available online at: https://www.gov.uk/government/statistical-data-sets/live-tables-on-land-use-change-statistics
[171] Countryside Survey (2007) *England Results from 2007*. Available online at: http://www.countrysidesurvey.org.uk/content/england-results-2007
[172] Defra (2006) *Sustainable Farming and Food Strategy – Indicator Data Sheet. Headline Indicator H5: Soil Quality – Soil Organic Matter.* Available online at: http://webarchive.nationalarchives.gov.uk/20080726153624/https://statistics.defra.gov.uk/esg/indicators/h5_data.htm
[173] Environment Agency (2004) *The state of soils in England and Wales*. Available online at: http://www.adlib.ac.uk/resources/000/030/045/stateofsoils_775492.pdf
[174] Defra (2012) *Farm Practices Survey Autumn 2012 - England*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/181719/defra-stats-foodfarm-environ-fps-statsrelease-autumn2012edition-130328.pdf

- to halt the decline of soil organic matter caused by agricultural practices in vulnerable soils by 2025; and
- to introduce a reviewed Soil Protection Review to make it a more effective tool for soil management.

The Natural Environment White Paper (2011) established an ambition that by 2030 all of England's soils will be managed sustainably and degradation threats tackled successfully, in order to improve the quality of soils and to safeguard their ability to provide essential ecosystem services and functions for future generations.

Scotland

Geology

No further information has been identified beyond those issues identified for the UK.

Land Use and Soils

In Scotland, most land is currently being lost to development in the central belt, with development in this area having doubled since the early 1980s and 1990s, though soil sealing in urban areas has not been accurately calculated as gardens, parks and other open spaces have not been accounted for. The total area of agricultural holdings in Scotland was 5.7 million hectares, equating to 73% of Scotland's total land area. Just over half of this comprised rough grazing, with about a quarter taken up by grass, and about ten per cent used for crops or left fallow. The rest consisted of woodland, ponds, yards or other uses. Additionally, almost 0.6 million hectares of land is used for the common grazing of livestock. Amongst the crops grown in Scotland, excluding grass, cereals accounted for 75% of the land area, with nearly two-thirds of that being barley (290,000 hectares). There were also considerable area growing wheat (110,000 hectares), oilseed rape (31,000 hectares) and potatoes (27,500 hectares). Amongst the 20,000 hectares of fruit and vegetables, a total of 1,000 hectares of strawberries were grown, mainly under cover, and was the largest source of income in horticulture[175].

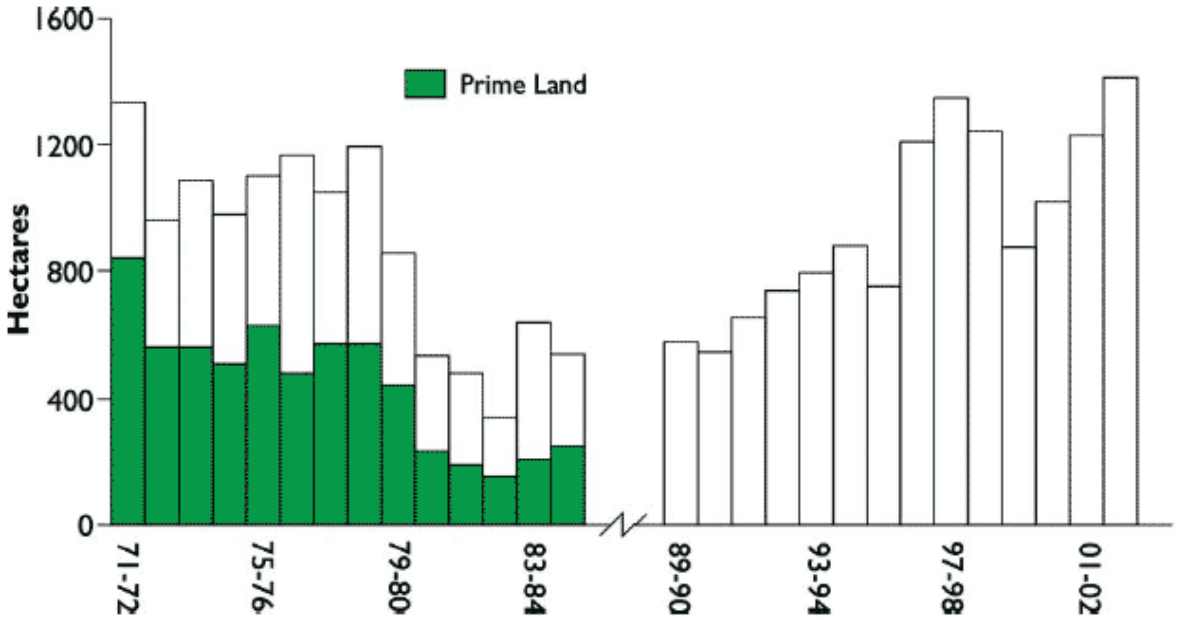
Scotland's land cover has been studied in both the Countryside Survey and by the National Countryside Monitoring Scheme (NCMS). The latter study is arguably outdated, being based on aerial photography interpretation with the last dataset dating to 1988. The principal findings with regard to this section include, since the 1940s:

- Built land increased by 46% mainly on grassland and farmland;
- Recreational land increased by 138%;
- Bare ground increased four-fold due to peat extraction and urban road development;
- Transport corridors increased by 22%; and
- Upland surfaced tracks increased by 29%[176].

Figure 4.3 indicates the area of agricultural land in Scotland lost to development over the last 30 years, which has been recently increasing.

[175] The Scottish Government (2017) *Agricultural land use in Scotland*. Available online at: http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/agritopics/LandUseAll
[176] Scottish Natural Heritage. *Land Cover Change in Scotland*. Available online at: http://www.snh.org.uk/publications/on-line/education/advances5/5-land-cover-change.asp

Figure 4.3 Conversion of Agricultural Land (Scotland)



Source: Scottish Government (2006) *Scotland's Soil Resource - Current State and Threats, Chapter 8.* Available online at: http://www.gov.scot/Publications/2006/09/21115639/11

The total amount of derelict and urban vacant land has decreased in each year between 2010 and 2016 (annual decreases ranging from 0.2% to 3%), except for 2014 when there was an increase of 2,090 hectares (19%) compared to 2013, largely due to over 2,200 hectares of former surface coal mine sites in East Ayrshire that had become derelict following the liquidation of Scottish Coal and ATH Resources in 2013. The total amount of derelict and urban vacant land in Scotland has decreased by 253 hectares (2%) in the latest year, from 12,688 hectares in 2015 to 12,435 hectares in 2016[177].

The 2007 Countryside Survey identified that the area of Broadleaved Woodland, Improved Grassland and Acid Grassland Broad Habitats increased by 9.5% in Scotland between 1998 and 2007. There was a corresponding decrease of 7.1% in the area of Coniferous Woodland. The area of the Arable and Horticulture Broad Habitat decreased by 13.6% between 1998 and 2007. There was a corresponding increase of 9.1% in the area of Improved Grassland, but no significant increase in the area of Neutral Grassland across Scotland as a whole. The changes in the areas of Broad Habitats in Scotland reflect short-term influences, such as agricultural economics, and medium-term influences, such as woodland planting and harvesting[178].

In Scotland, an estimated 27,000 inspections of land with the potential to be contaminated have already been or are in the process of being undertaken (equating to an estimated 40% of all such sites). A total of 807 sites (equivalent to 1,864 hectares) of land that was affected by contamination have been remediated[179].

There is some evidence that soils are becoming slightly less acidic in some areas of Scotland due to reduced acid deposition. Ecological damage to soils caused by run-off from roads and urban areas is likely to increase. Agricultural land is being developed at twice the rate as in the

[177] The Scottish Government (2017) *Scottish Vacant and Derelict Land Survey 2016*. Available online at: http://www.gov.scot/Resource/0051/00516905.pdf
[178] Countryside Survey (2007) *Scotland Results from 2007*. Available online at: http://www.countrysidesurvey.org.uk/content/scotland-results-2007
[179] Scottish Environment Protection Agency (2009) *Dealing with land contamination in Scotland: A review of progress 2000-2008.*

1990s. This development is likely to have occurred on some of Scotland's versatile and productive soils. There is some evidence that levels of organic matter may be declining[180].

Studies in Scotland indicate that land-use practices which leave bare soil during the winter months are particularly damaging, especially in lowland sandy/cultivated mineral soils, though single events may be confined to small areas. In the uplands, peat has been shown to be susceptible to erosion which has implications for carbon storage and erosion of any soil has implications for most soil 'functions'[181].

Scotland's Land Use Strategy for 2016-2021 takes a strategic approach to the challenges facing land use in Scotland and sets out the following vision: "*A Scotland where we fully recognise, understand and value the importance of our land resources, and where our plans and decisions about land use deliver improved and enduring benefits, enhancing the wellbeing of our nation.*" Overall, the Scottish Government concludes that in the future, the challenges facing Scotland's soil will be to understand and deal with a number of issues including:

- the need for policy integration: understanding the role of soil in existing policy and developing recommendations for future soil policy to ensure soil is sufficiently protected;
- tackling the lack of systematic Scottish soil data: understanding what information is already available, identifying gaps and making recommendations for future soil monitoring; and
- understanding soil management and providing recommendations for targeting practical management options to minimise soil degradation and its consequences[182].

Wales

Geology

No further information has been identified beyond those issues identified for the UK.

Land Use and Soils

In Wales, between 1998 and 2007 the area of built land has increased by 12.5%. Most Broad Habitats did not change significantly in area between 1998 and 2007 when averaged across Wales as a whole. However, a number of statistically significant changes in area have been noted between 1998 and 2007. In the lowland zone of Wales Broadleaved, Mixed and Yew Woodland increased, and in the upland zone, Arable and Horticultural Land increased, Neutral Grassland decreased and Acid Grassland increased. The possible drivers of these changes are unknown and require further research[183].

No baseline data has been identified in relation to previously developed land in Wales and therefore trends could not be established. However, similar to recent trends in England, the

[180] SNIFFER (2008) *Strategic Environmental Assessment DRAFT Practical Guidance for Practitioners on How to Take Account of Soil. Section 2 – Soil*. Available online at: http://www.snh.gov.uk/docs/A183002.pdf
[181] Scottish Government (2006) *Scotland's Soil Resource - Current State and Threats. Chapter 6 Soil Erosion*. Available online at: http://www.gov.scot/Publications/2006/09/21115639/9
[182] Scottish Government (2017) *Soils*. Available online at: http://www.environment.scotland.gov.uk/get-informed/land/soils/
[183] Countryside Survey (2007) *Wales Results from 2007*. Available online at: http://www.countrysidesurvey.org.uk/content/wales-results-2007

trend in land use may be generally towards increased development on land that has not previously been developed.

A total of 10,130 potentially contaminated sites had been brought to the attention of local authorities in Wales, with 175 determined as 'contaminated land' in Wales by the end of 2013.

Assessing Significance

The objectives and guide questions related to land use, geology and soils which have been identified for use in the appraisal of the effects of Geological Disposal Infrastructure NPS proposals are set out in **Table 4.7**, together with reasons for their selection.

Table 4.7 Approach to Assessing the Effects of the Geological Disposal infrastructure NPS on Land Use, Geology and Soils

Objective/Guide Question	Reasoning
Objective: To conserve and enhance soil and geology and contribute to the sustainable use of land.	The SEA Directive (2001/42/EC) requires that likely significant effects on soil and resources be taken into account in the Environmental Report, which for the purposes of the AoS is incorporated within the AoS Report.
Will the Geological Disposal Infrastructure NPS have an effect on soil quality/function, variety, extent and/or compaction levels?	Loss of soil quality, variety, extent or an increase in soil compaction will lead to degradation of soil. The European Thematic Strategy on Soil Protection seeks the protection and sustainable use of soil, preventing soil degradation and ensuring restoration of degraded soils.
Will the Geological Disposal Infrastructure NPS increase the risk of significant land contamination?	Environment Act 1995 seeks to protect and preserve environment against pollution to land. The Soil Strategy for England (2009) and Scottish Soil Framework (2009) include objectives on reducing/preventing soil pollution and contamination.
Will the Geological Disposal Infrastructure NPS have an effect on any known and existing contamination?	Significant areas of the UK carry a burden of contamination from industrial activity. Disturbance of contaminated sites carry the risk of pollution pathways being created or re-opened for existing ground contamination.
Will the Geological Disposal Infrastructure NPS protect and/or enhance Geological Conservation Sites, important geological features and geophysical processes and functions?	National planning policy in England, Scotland and Wales seeks to protect and enhance geological conservation interests.
Will the Geological Disposal Infrastructure NPS affect land stability?	A key challenge is to ensure the correct identification and selection of geological sites, based on a risk assessment of specific geological features.
Will the Geological Disposal Infrastructure NPS change patterns of land use including effects on best and most versatile agricultural land?	National and local planning policies set out that planning should use of previously developed land where possible, and avoid using best and most versatile land.

Objective/Guide Question	Reasoning
Will the Geological Disposal Infrastructure NPS affect induced seismicity?	Research from Durham and Newcastle University has identified a range of anthropogenic causes of seismic activity including mining and petroleum exploration and production (see Wilson, M, Davies, R, Foulger, G, Julian, B, Styles, P, Gluyas, J and Almond, S, *Anthropogenic earthquakes in the UK: A national baseline prior to shale exploitation*, Marine and Petroleum Geology, 2015). Given the likely range of excavation and mining techniques, and the uncertainty over host geology at this stage, there remains the possibility that such activities could lead to induced seismicity. Furthermore, due to the media profile of other boring and drilling activities, notably for unconventional oil and gas, there are public concerns over the issue of induced seismicity, even if the perception of risk is disproportionate to the actual risk. It should also be noted that in response to AoS scoping consultation, the EA requested that consideration was given to seismicity (comment EA10, in Appendix D of the AoS Report). In consequence, due to the available evidence, public concern and the request from the EA, the AoS has included the consideration of induced seismicity.

Table 4.8 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the land use, geology and soils objective.

Table 4.8 Illustrative Guidance for the Assessment of Significance for Land Use, Geology and Soils

Effect	Description	Illustrative Guidance
++	Significant positive	• Option would restore and significantly improve soil quality and land stability to conditions beyond current levels and remove all soil contamination so that soil functions and processes would be significantly improved in the long term; • Option would minimise the use of, and protect from irreversible damage, high quality agricultural land; • Option would have a significant and sustained positive impact on national designated geological sites; • Option would seek to minimise the use of any undeveloped land, and look to preferentially reclaim and redevelop significant areas of previously developed or derelict land.
+	Positive	• Option would generate minor improvements in soil quality and land stability and would remove some soil contamination so that soil functions and processes would be improved in the long term; • Option would reduce any potential damage to high quality agricultural land; • Option would reduce any potential hazard associated with existing soil contamination; • Option would have a minor and temporary positive impact on a national designated geological site; • Option would seek to preferentially make use of previously developed land.
0	Neutral	• Option would not significantly affect potential hazards associated with any existing contamination; • Option would not cause damage or loss to soil such that soil function and processes would not be affected; • Option would not affect land stability; • Option would not involve significant loss of any undeveloped or developed land.
-	Negative	• Option would lead to an increase in pollutant discharges to soil; however, these would be less than permitted limits, such that there would be minor short-term increases in land contamination; • Option would cause minor increases in potential hazards associated with existing soil contamination; • Option would cause minor increases in potential hazards associated with land stability; • Option would cause a temporary loss of soil so that soil function and processes would be negatively affected in the short/medium term; • Option would cause minor short-term negative effects on geological conservation sites/important geological features or soils of high importance; • Option would lead to the majority of development using undeveloped land or land that has reverted to a ‘wild’ state.

Effect	Description	Illustrative Guidance
--	Significant negative	• Option would lead to a statutory limit being reached or exceeded in relation to land contamination, such that there would be a major and sustained increase in land contamination; • Option would cause major and sustained increases in potential hazards associated with existing soil contamination; • Option would cause major increases in potential hazards associated with land stability; • Option would cause considerable loss of soil quality, such that soil function and processes would be irreversibly and significantly affected; • Option would cause a substantial and permanent loss of, or damage to, soil of high importance (such as best and most versatile agricultural land) and/or designated geological conservation sites/important geological features; • Option would not develop derelict or previously developed land, but would lead to development of significant areas of undeveloped land/ land that has reverted to a 'wild' state.
?	Uncertain	• From the level of information available, the effect that the option would have on this objective is uncertain.

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 4.9 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria[184]' and 'No NPS' on the Land use, Geology and Soils objective. The appraisal considers in-turn the three sub-sections used for each topic within Chapter 5 (Impacts) of the draft NPS: Applicant's Assessment; Decision Making and Mitigation. Land use is considered as a stand-alone topic in Section 5 of the draft NPS. Geology and soils are considered under different sections. The performance of the draft NPS and the two reasonable alternatives are scored accordingly, with a commentary provided in the Appraisal column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15 - 20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement. These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-term (less than 20 years), MT – medium-term (between 20 and 170 years) and LT – long-term (>170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

[184] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

Table 4.9 Appraisal of the Draft NPS and Reasonable Alternatives: Land use, Geology and Soils

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	**+/?**	**+?/**	**+/?**	**Draft NPS:** ***Land Use*** The text in the draft NPS under the heading of the Applicant's Assessment states that: 5.11.5 "*The Environmental Statement (see Section 4.2) should identify:* • *existing and proposed*[185] *land-uses near the development,* • *the effects of replacing an existing development; and* • *whether the use of the site with the proposed development could prevent a development or use on a neighbouring site from continuing."* *If the proposed geological disposal infrastructure would prevent a new development or a use proposed in a development plan, the applicant should make an assessment of the effects of preventing that development or use."* 5.11.6 "*Applicants considering proposals which would involve developing on open space, sports or recreational buildings and land should have regard to the local authority's assessment and will need to consult the local community. Taking account of the consultations, applicants should consider providing new or additional open space including green infrastructure, sport or recreation facilities (to substitute for any losses as a result of their proposal). Applicants should use any up-to-date local authority assessment or, if there is none, provide an independent assessment to show whether the existing open space, sports and recreational buildings and land is surplus to requirements."* 5.11.7 "*During any pre-application discussions with the applicant, the local planning authority should identify any concerns it has about the impact of the application on land-use. In doing so, the local planning authority should have regard to the development plan and relevant applications and including, where relevant, whether it agrees with any independent assessment that the land is surplus to requirements.* 5.11.8 "*Applicants should take into account the economic and other benefits of land. Applicants should seek to minimise impacts on the best and most versatile agricultural land (defined by the Defra owned Agricultural Land Classification (ALC) system as land in grades 1, 2 and 3a). Where significant development on agricultural land is demonstrated to be necessary, applicants should use poorer quality land (grades 3b, 4 and 5) where possible to minimise impacts on soil quality (except where doing so would be inconsistent with other sustainability considerations). Applicants should also identify any effects on soil quality and show how they would minimise those effects including by proposing appropriate mitigation measures."* 5.11.9 "*The general policies controlling development in the countryside apply with equal force in Green Belts; however, there is, in addition, a general presumption against inappropriate development within them. Such development should not be*

[185] For example, where a planning application has been submitted.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				approved except in very special circumstances. Applicants should therefore determine whether their proposal, or any part of it, is within an established Green Belt and if it is, whether their proposal may be inappropriate development within the meaning of Green Belt policy." 5.11.10 "*Infilling or redevelopment of major developed sites in the Green Belt, if identified as such by the local planning authority, may be suitable for geological disposal infrastructure. It may help to secure jobs and prosperity without further prejudicing the Green Belt or offer the opportunity for environmental improvement. Applicants should refer to relevant criteria[186] on such developments in Green Belts."* 5.11.11 *"An applicant may be able to demonstrate that a deep borehole, in relation to Green Belt policy may be considered as an 'engineering operation' rather than a building, and therefore may not be inappropriate development provided it preserves the openness of the Green Belt and does not conflict with the purposes of including land within the Green Belt. It may also be possible for an applicant to show that the physical characteristics of proposed surface-based parts of geological disposal infrastructure are such that it would have no adverse effects which could conflict with the fundamental purposes of Green Belt designation."* 5.11.12 "*An applicant for geological disposal infrastructure may find that the only viable sites for meeting the need for geological disposal infrastructure are on Green Belt land. An applicant needs to recognise the special protection given to Green Belt land. The Applicant would need to demonstrate, and the Secretary of State should be satisfied, that very special circumstances existed to justify granting development consent for development that is inappropriate in terms of Green Belt policy."* ***Geology*** 5.11.13 "*Where the proposed development is likely to have an effect on the availability of mineral or hydrocarbon resources the applicant should undertake an assessment of the existing status of resources and any impacts of the proposed project development on their availability."* ***Soils*** 5.13.7 "…*The applicant must demonstrate that all waste produced by the facility will be managed in accordance with the waste hierarchy outlined in paragraph 5.13.4 above and that, during construction, excavated* ***soil, subsoil and rock will, where possible, be reused.****"* Given the range of factors identified, in the context of the applicant's assessment, the draft NPS is assessed as having a positive effect in relation to land use, geology and soils. However there is also uncertainty because site specific effects are unknown at this time. *Recommendations for Improvement* The NPS could reference the National Planning Practice Guidance in relation to soils which states that the planning system should protect and enhance valued soils and prevent the adverse effects of unacceptable levels of pollution. This is because

[186] See National Planning Policy Framework paragraphs 79 - 92.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				soil is an essential finite resource that provides important 'ecosystem services', PPG Natural Environment, Paragraph: 025 Reference ID: 8-025-20140306. The NPS could also reference the NPPF and Environmental Protection Act 1990 in relation to land use, geology and soils. The NPPF seeks to ensure that sites are suitable for new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation. After remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990. In principle, excavations into the host rocks could affect the physical or chemical stability or the background level of seismicity of the surrounding geology. However, significant adverse effects are not anticipated as a stable geological environment is essential for a GDF and the developer will need to demonstrate the long-term geological stability of the facility to safety and environmental regulators. However, the need to consider geological stability, faulting and the effects of natural and induced seismicity could be highlighted in this section. Given the scale of the proposals the draft NPS could be amended to require a Soil Management Plan, which would give specific consideration to the management of soil as a resource (rather than 'waste'). The Plan would need to be site specific, identifying the best way to manage/use materials depending on the geological environment, e.g. rock type etc. The draft NPS could encourage the use of materials on site first, in order to reduce the need to transport material. This could be particularly relevant if the siting of the GDF included the best and most versatile agricultural land. As part of the Government's 'Safeguarding our Soils' strategy, Defra has published a code of practice on the sustainable use of soils on construction sites, which may be helpful in development design and setting planning conditions. Developers could be asked to develop their applications in light of this and other more detailed guidance, for example: • Defra and EA, CLR 11: Model Procedures for the Management of Land Contamination. • BS 3882:2015: Specification for topsoil and requirements for use. • BS 6031:2009 Code of Practice for Earth Works. • BS 10175:2011+A1:2013: Investigation of Potentially Contaminated Sites. Code of Practice. • CIRIA Report C741: Environmental Good Practice on Site (fourth edition). There is potential for a proposed GDF and associated activities to impact on marine related uses in addition to land uses. Activities and facilities envisaged that could have effects on the marine environment could include: • Nearshore drilling activities to determine geological suitability of offshore geology; • Surface access at or near coast to underground GDF tunnels and vaults which extend offshore; however, it is assumed that the surface facility will be located entirely on-shore;

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• Port/freight handling facilities (and associated shipping movements) for any construction materials and potentially HAW. In addition to the potential localised effects on marine activities, such infrastructure would 'sterilise' an area from any further near shore/offshore development (which would then need to be reflected in the relevant nearshore marine plan). Consideration should be given to providing further guidance on the possible contents of the ES with regards to land use/marine activity, geology and soils. In relation to land use, geology and soils the ES might be expected to cover: • The baseline characteristics and conditions of land use/marine activity, geology and, soils within the study area, including reference to agricultural land classifications; • The identification of all land uses and soils within and adjacent to the Main Development Site that may be affected by the construction and operation of the proposed development; • The identification of any other planned activities which could affect land use, geology and soils and the proposed GDF infrastructure e.g. any licensed conventional or unconventional onshore oil and gas activities; • Assessment of the likely significant effects of the proposed development on land use, geology and soils taking account of temporary and permanent land-use requirements and site restoration; • Measures, if appropriate, to mitigate potential significant adverse effects on land use/marine activity, geology and soils.
				Draft NPS including Exclusionary Criteria: The exclusionary criteria as currently proposed do not exclude areas of the basis of soil, land use or geology. However, excluding areas based on landscape, heritage and nature conservation designations may have some indirect benefits for some soil types, such as upland peat areas (although this will be limited). In consequence, the performance of this alternative is not considered to be materially different from the draft NPS, and so will have the same potential benefits and uncertainties.
				No NPS: Under this alternative land use, geological and soils considerations would be considered in accordance with planning policy and the amended EIA Regulations. The opportunity for the NPS to provide clarity and further guidance, with Section 5 outlining the broad scope of any assessment in relation to this topic would be lost in the absence of the NPS.
Decision Making	**+/?**	**+/?**	**+/?**	**Draft NPS:** ***Land use*** 5.11.14 "*Where the proposed development conflicts with a proposal in a development plan, the Secretary of State should take account of the stage which the development plan document in England has reached. In deciding what weight to give to*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				the plan for the purposes of determining the planning significance of what would be replaced, prevented or precluded, the closer the development plan document (in England) is to being adopted by the local planning authority, the greater weight which can be attached to the impact of the proposal on that development plan[187]*."* 5.11.15 "*The Secretary of State should not grant consent for development on existing open space, sports and recreational buildings and land unless:* • *an assessment has been undertaken, either by the local authority or independently, which has shown the open space or the buildings and land to be surplus to requirements; or* • *the benefits of the development (including need), outweigh the potential loss of such facilities, taking into account any positive proposals made by the applicant to provide new, improved or compensatory land or facilities. The loss of playing fields should only be allowed where an applicant can demonstrate that they will be replaced with facilities of equivalent or better quantity or quality in a suitable location."* 5.11.16 "*Where networks of green infrastructure have been identified in development plans, they should normally be protected from development and, where possible, strengthened by or integrated within it."* 5.11.18 *"In considering the impact on maintaining coastal recreation sites and features, the Secretary of State should expect applicants to have taken advantage of opportunities to maintain and enhance access to the coast. In doing so, the Secretary of State should consider the implications of development for the creation of a continuous signed and managed route around the coast, as provided for in the Marine and Coastal Access Act 2009."* 5.11.19 *"When located in the Green Belt, some geological disposal infrastructure may be deemed 'inappropriate development*[188]*. The Secretary of State will need to assess whether there are very special circumstances to justify development consent for inappropriate development. Very special circumstances will not exist unless the harm by reason of inappropriateness, and any other harm, is outweighed by other considerations. In view of the presumption against inappropriate development, the Secretary of State will attach substantial weight to the harm to the Green Belt when considering any application for such development."* ***Geology*** 5.4.14 "*Sites of regional and local biodiversity and geological interest, which include Regionally Important Geological Sites, Local Nature Reserves and Local Sites, have a fundamental role to play in:* *a) meeting overall national biodiversity targets;* *b) contributing to the quality of life and the well-being of the community; and* *c) supporting research and education.*

[187] See the National Planning Policy Framework for national policy on the weight to be given to policies in emerging plans.
[188] See National Planning Policy Framework paragraphs 79 - 92.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				The Secretary of State should give due consideration to such regional or local designation. However, given the need for geological disposal infrastructure, these designations should not be used in themselves to refuse development consent." 5.4.7 "*In taking decisions, the Secretary of State should ensure that appropriate weight is attached to designated sites of international, national and local importance*…." 5.11.20 "*The Secretary of State should consider whether the proposed development will have a significant impact on the recovery of natural resources, including minerals and hydrocarbons. Should the Secretary of State deem the loss (economic or otherwise) of natural resources as a result of the proposed development to be too great, development consent should be refused."* ***Soils*** 5.11.17 (our emphasis); "*The Secretary of State should ensure that justification is provided where an applicant seeks development consent for infrastructure to be located on the best and most versatile agricultural land. The Secretary of State should give little weight to the* ***loss of poorer quality agricultural land (in grades 3b, 4 and 5), except in areas (such as uplands) where particular agricultural practices may themselves contribute to the quality and character of the environment or the local economy****. The Secretary of State should also take account of any* ***loss of high quality soil, including by having regard to the value of peat for biodiversity and as a carbon store, as well as taking account of whether the proposal gives rise to any risk of soil contamination****."* Given the range of factors identified, in the context of the decision making criteria, the draft NPS is assessed as having a positive effect in relation to land use, geology and soils. However there is also uncertainty because there could be significant effects on features of acknowledged importance in the absence of exclusionary criteria. *Recommendations for Improvement* The need to consider geological stability, faulting and the effects of natural and induced seismicity could be highlighted in this section.
				Draft NPS including Exclusionary Criteria: The exclusionary criteria as currently proposed do not exclude areas of the basis of soil, land use or geology. However, excluding areas based on landscape, heritage and nature conservation designations may have some indirect benefits for some soil types, such as upland peat areas (although this will be limited). In consequence, the performance of this alternative is not considered to be materially different from the draft NPS, and so will have the same potential benefits and uncertainties.
				No NPS: Applications would be subject to the provision of nationally planning policy and EIA Regulations under this alternative which would require consideration of the effects on land use, geology and soils. In consequence, even without the NPS, it would therefore still be considered to have a positive effect in relation to these topics, the absence of a clear statement of the full range of considerations to be taken into account (as proposed in the NPS) risks inconsistency in interpretation, particularly at a project level.
Mitigation	**+/?**	**+/?**	**+/?**	**Draft NPS:**

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Land use 5.11.21 *"An applicant should seek to minimise the direct effects of proposed development on the existing use of the proposed site, or proposed uses near the site, by the application of good design principles, including the layout of the proposed development."* 5.11.22 "*Where green infrastructure is affected, the Secretary of State should consider imposing requirements to ensure the connectivity of the green infrastructure network is maintained in the vicinity of the development and that any necessary works are undertaken, where possible, to mitigate any adverse impact."* 5.11.23 "*Where a proposed development has a sterilising effect on land use there may be scope for this to be mitigated through, for example, using or incorporating the land for nature conservation or wildlife corridors or for parking and storage in employment areas."* 5.11.24 "*Coast access, rights of way, National Trails and other rights of access to land are important recreational facilities, for example, for walkers, cyclists and horse riders. Applicants are expected to take appropriate mitigation measures to address adverse effects on coastal access, National Trails and other rights of way. Where this is not the case, the Secretary of State should consider what appropriate mitigation requirements might be attached to any grant of development consent."* ***Geology*** 5.11.25 "*Where significant disruption to the recovery of natural resources cannot be avoided or mitigated, as a last resort, appropriate compensation measures should be sought. If these conditions cannot be met, development consent should not be granted."* The mitigation could be revised to be more specific and clearly reflect the potential effects associated with the key project stages of site investigation, construction, operation and closure, as summarised below. ***Soils*** The draft NPS does not put forward any mitigation measures in relation to soils. Given the range of areas where mitigation is identified as needing to be considered, the draft NPS is assessed as having a positive effect in relation to land use, geology and soils. However there is also uncertainty because the criteria could be broadened out to consider a broader range of factors, including mitigation in relation to soils. Additional mitigation is discussed below. *Recommendations for Improvement* The following text draws on the Geological Disposal Generic Environmental Assessment Report (December 2016) produced by Radioactive Waste Management Ltd (the 2016 Report). *Site Investigation* It is assumed that the borehole drilling programme would involve temporary land take for compounds associated with up to 20 deep boreholes within a target of approximately 10km^2 with the possibility of one or more deep boreholes outside of the target area. Based on current understanding, it is thought likely that each compound would be occupied for approximately 6 months at any single location. The effects cannot be assessed in detail until the location of the affected community(s) and the survey areas are known, and therefore the nature of the affected land. The potential for mitigation in relation to marine

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				related uses could be explored if any site investigation activities took place within the marine environment. For greenfield sites generic potential effects during detailed site investigation (borehole drilling) activities on land use, geology and soils could include (Appendix B, Tables 4 and 11 of the 2016 Report): • Damage to agricultural soils and/or drainage or water supply systems; • Damage to the agricultural land quality according to the Ministry of Agriculture Fisheries and Food Agricultural Land Classification System (1988); • Temporary loss or severance of agricultural land, agricultural productivity, agricultural access and disruption of agricultural practices; • Temporary loss or severance of community resources such as land use by the community, public rights of way or other recreational land or facilities; • Temporary removal of topsoil and subsoil during the construction of borehole drilling pads, support infrastructure and access roads; • Low level contamination to soils (for example silty water, drill fluid/oil spills); • Disturbance/remobilisation of existing contaminants (more likely on brownfield than greenfield sites); • Between 75 and 100m^3 of rock per year would be removed for testing and analysis; and • Drilling could affect recognised important geological sites (for example SSSI or RIGS) if boreholes were located in such sites. The potential for significant effects cannot be considered fully at the generic stage but could in principle be avoided by the siting of boreholes. Potential mitigation measures identified in the 2016 Report include: • Full consideration of land-use effects in siting process; • In detailed design of site-based investigations, seek to minimise number of sites required & extent of land required at each site; • Locate drilling sites with reference to existing roads/tracks to minimise length of new temporary access tracks; • Consult landowners and tenant farmers in selecting locations and access routes to minimise disruption; • Seek to locate drilling sites, site offices on previously developed land where it is available in suitable locations; • Seek to avoid existing community resources where possible, including public rights of way; • Develop a site-specific soil handling strategy in liaison with appropriate stakeholders in accordance with the best practice guidance (Defra 2009 Guide for the Sustainable Use of Soils on Construction Sites) to effectively reinstate the disturbed areas to their former agricultural use;

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• Consider balance between land-use and community effects and mitigation requirements of other topics which may require the use of additional land; • Design site investigation works to avoid designated sites (SSSIs and RIGS) unless no other suitable site is practicable; • Strip topsoil ahead of works. All soil handling, storage and management to be in suitable (dry) conditions and according to relevant guidelines and an appropriate management plan; • Store different soil types separately and minimise duration of storage; • Avoid soil compaction on site and while in storage; • Establish grass cover on soil mounds; • Seek opportunities for beneficial re-use of drill cuttings to avoid disposal as waste, where practicable in light of commercial, technical and environmental factors. *Construction* In relation to geology and soils, key impacts arising from the construction of surface facilities could include: • Removal of soil and near-surface rock within a GDF surface site footprint (the effects arising from the creation of waste rock from the construction of the underground facilities is addressed in the waste appraisal topic); • Disturbance/remobilisation of relict contamination (more likely on brownfield rather than greenfield sites); • Standard construction risks such as contamination from spillage of fuels, oils etc. Unlike during the site investigation activities, land-take effects in the construction phase would be long-term, generally lasting at least until the end of the closure phase. Adverse effects could include: • Loss of agricultural and/or recreational/community land; • Loss of agricultural or other soils; • It may also be necessary to take additional land for environmental mitigation measures; • Severance/disruption to agricultural drainage, water supply and access systems; • Conflict with land-use related policy at national or local level (to be weighed against the strategic importance of the GDF in national policy terms). Potential mitigation measures identified in the 2016 Report include: • Ensure that rights of access for maintenance are secured to any off-site mitigation features; • Ensure that community effects are reduced as far as practicably possible, including the temporary diversion of public rights of way, where required, to maintain the connectivity of the network. These measures would be subject to

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				consultation with the relevant stakeholders including local authorities and access groups; • Ensure that potential effects on soils and agricultural land quality are reduced as far as possible; • Avoid sites with existing contamination or, if such a site is selected, advance remediation of the site to remove contamination. Such remediation could provide a positive benefit to a local community; • Careful planning of the works and application of an environmental management plan to prevent contamination, spills; • Ensure that any soils stripped from site to be handled and stored as per construction phase, and in accordance with a management plan; • Ensure that all soils stripped from site to be re-used in landscaping or otherwise beneficially/ sustainably re-used within two years; and • Ongoing maintenance of the GDF estate, including any off-site environmental mitigation features (to be covered in the operational phase environmental management plan). In addition to the mitigation measures identified in the 2016 Report it is suggested that the draft NPS could specify the requirement for a Resource Management Plan, including consideration of soils, but this could be broadened out to include other materials. The NPS could also highlight the need to consider effects on farms as agricultural units (and a land use), e.g. the need to ensure that farms remain viable if affected by the loss of land or farms are affected by severance. *Operation & Closure* If surface operational activities extend outside of the site area there may be additional effects on soil reserves and sites of geological value. Standard risks on any site operating large plant would apply, including potential contamination from spills of fuels, oils, etc. The 2016 Report identifies the following mitigation measures in relation to closure: • Careful preparation of site for reinstatement. • Careful selection of soils for reinstatement of site – source of soils/soil type to be appropriate to the local geology and ecological context and from the nearest available location while avoiding negative effects at the source site. • Soils to be restored onto a stable but permeable substrate, on appropriate gradients, with appropriate aftercare regime in place. There will be a need to ensure that arrangements are in place through the planning process for securing a beneficial use of the site after closure. This could include the need to consider long-term arrangements for managing the area once the GDF is closed. The 2016 Report identifies the need for a restoration strategy and consideration of potential after-uses of the land as the time of closure approaches, with input from local stakeholders. The 2016 Report also highlights the need to give careful consideration to any impacts on communities and community resources resulting from the closure of the site, in consultation with the relevant local authorities.

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				Draft NPS including Exclusionary Criteria: The exclusionary criteria as currently proposed do not exclude areas of the basis of soil, land use or geology. However, excluding areas based on landscape, heritage and nature conservation designations may have some indirect benefits for some soil types, such as upland peat areas (although this will be limited). In consequence, the performance of this alternative is not considered to be materially different from the draft NPS, and so will have the same potential benefits and uncertainties.
				No NPS: Under this alternative land use, geological and soils considerations would be considered in accordance with planning policy and amended EIA Regulations. Opportunity for the NPS to provide clarity and further guidance, with Section 5 outlining the broad scope of any assessment in relation to socio-economic considerations would be lost in the absence of the NPS.
Other Sections of the Draft NPS Relevant to Land Use, Geology and Soils	**1. Introduction** 1.1.3 There is an opportunity for the consideration of effects on land use, geology and soils in a specific locality through the preparation of a local impact report submitted by a local authority in accordance with the Planning Act. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on relevant issues, helping to ensure that consideration is given to likely effects in a particular locality. 1.1.4 Consideration of land use, geology and soils is reflected in the need to apply the NPS in the context of section 104 of the Planning Act. This should help ensure that related effects, (both positive and negative), in so far as they are relevant to planning, are balanced. The net result of this balancing exercise could be uncertain, however. **1.4 Consideration of deep boreholes investigations** – the role and content of an Environmental Statement, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of land use geological and soils interests, including the potential for cumulative effects – by setting out these principles, the NPS has a positive impact in relation to the consideration of these topics and other issues as part of the consenting process. **1.5 Consideration of geological disposal facilities** - the spatial disposition of facilities and the timescale of development could affect land use and other aspects of this topic, although the requirements for limiting cumulative negative impacts within safety and reasonable financial constraints should help to minimise impacts. **2. Government Policy on Management of Higher Activity Radioactive Waste** 2.2.6 The preference for disposal through a single site will help to confine effects to a specific area thus limiting the likely extent of any effects on this topic, although these could still be significant in respect of that particular site. 2.4.3 The strategy for implementation provides for the opportunity to consider this topic as the process proceeds iteratively, including discussions with communities of interest. This could include opportunities to optimise positive outcomes in relation to this topic, e.g. in terms of avoiding severance or loss of existing land-uses that are valued locally or the introduction of new uses as part of planning gain. **3. The Need for Geological Disposal Infrastructure -** No direct relationship identified. **4. Assessment Principles** **4.1 General principles of assessment** - The provisions of the Planning Act and the policies and protections set out in the NPS provide for a balanced consideration of needs. The requirement for the identification of adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for the protection and enhancement of land use, geological and soils related interests. **4.2 Environmental Impact Assessment** – the consideration of proposals within the EIA Regulations and the preparation of an Environmental Statement (where required)				

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	agreed by statutory agencies and specifying mitigation and enhancement measures will ensure that this topic is fully considered, as will the consideration of cumulative effects and interrelationships between effects. **4.3 Habitats Regulations Assessment** – no direct relationship identified. **4.4 Alternatives** – the requirement that reasonable alternatives will need to be considered by the developer as part of scheme design and project planning should ensure that this topic is taken into account, both in terms of protection and opportunities for mitigation and enhancement. **4.5 Criteria for 'good design for geological disposal infrastructure** – attention to good design principles and implementation will be of benefit to land use through the consideration of how a proposed facility interacts with its context, this could include consideration of connectivity and access to facilities etc. Good design could include the sustainable use of soils and other materials. **4.6 Climate Change Adaptation** – Ensuring that any development is appropriately adapted to future climate change will help avoid impacts on this topic associated with closure or impacts on operations. **4.7 Pollution Control and other Environmental Regulatory Regimes** – the protection provided by other legislative provisions highlighted in the draft NPS will be important in helping to avoid effects on adjoining uses and soils associated with development. **4.8 Common Law Nuisance and Statutory Nuisance** – 4.8.2 notes that: *"It is very important that, during examination of a nationally significant infrastructure project, the Examining Authority considers possible sources of nuisance under Section 79(1) of the Environmental Protection Act 1990, and how they may be mitigated or limited. This will enable the Examining Authority to recommend appropriate requirements that the Secretary of State may wish to include in any subsequent order granting development consent."* Provisions in relation to statutory nuisance will help ensure that significant effects in relation to any adjoining land uses are avoided. **4.9 Safety** – The NPS highlights the role of other safety regimes and the need for the Secretary of State to have regard to health and safety legislation applying to the construction and operation of geological disposal infrastructure. This primarily relates to the health topic considered elsewhere in this AoS but there are also broader benefits relating to the consideration of other land uses that might be affected, e.g. recreation. **4.10 Health** – This section highlights the need for the Environmental Statement to consider effects on human beings and include measures to avoid, reduce or compensate such impacts as appropriate. The effects include access to land uses, including employment, open space and water for recreation and physical activity (4.10.1 refers). **4.11 Security Considerations** – This section of the draft NPS outlines established security considerations and responsible Government departments, which would apply to a GDF. These considerations would apply irrespective of whether or not the NPS was in place so no additional environmental effects are anticipated.			
Summary Appraisal of Likely Significant Effects	**+/?**	**+/?**	**+/?**	**Draft NPS:** The NPS identifies the need to consider soils and contamination. The impact on existing areas of contamination is unknown at this stage as it is a project specific issue, however the need to take the potential for contamination into account in the decision making process should have a positive effect. The need to protect Geological Conservation Sites is noted in the draft NPS but development affecting them is not ruled out. Effects on land stability will be a material consideration. There is potential for the NPS to indirectly affect soil quality/function, variety, extent and/or compaction levels through the projects that are consented in accordance with it. A GDF could impact on the risk of significant contamination but there are other regulatory controls in place to avoid this. The extent to which the NPS will affect existing contamination is uncertain as this will depend on where the GDF is located. Impacts on land use and best and most versatile agricultural land are highlighted as a material consideration. The potential for impacts on Green Infrastructure is identified as a material consideration. The NPS protects important geological features in so far as any potential effect on them will be a material consideration but it does not preclude their loss. Hence the overall assessment is positive but uncertain. Other parts of the NPS also contribute to the positive appraisal against the objective relating to land use, geology and soils.

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				Draft NPS including Exclusionary Criteria: The exclusionary criteria as currently proposed do not exclude areas of the basis of soil, land use or geology. However, excluding areas based on landscape, heritage and nature conservation designations may have some indirect benefits for some soil types, such as upland peat areas (although this will be limited). In consequence, the performance of this alternative is not considered to be materially different from the draft NPS, and so will have the same potential benefits and uncertainties.
				No NPS: Applications would be subject to the provision of nationally planning policy and EIA Regulations under this alternative which would require consideration of the effects on land use, geology and soils. In consequence, even without the NPS, there would therefore still be considered to be a positive effect in relation to these topics, the absence of a clear statement of the full range of considerations to be taken into account (as proposed in the NPS) risks inconsistency in interpretation, particularly at a project level.
Summary of Recommending Mitigation and Enhancement	The draft NPS makes a positive contribution to the land use, geology and soils objective. It identifies a range of issues that should be considered in terms of preparing and determining an application and mitigation. Effects remain uncertain because the draft NPS sets out a range of factors, e.g. Best and Most Versatile Agricultural land but does not rule out its loss. Additional mitigation is suggested and is summarised below: • The section could be titled: Land Use, Soil and Geology to reflect the issues it covers. • The section could give greater consideration to potential impacts on marine uses and the need to consider these at each stage. • The draft NPS could specify the requirement for a Resource Management Plan, including consideration of soils, but this could be broadened out to include other excavated material. The draft NPS could make it clear that there is a preference for materials to be re-used on site where feasible and cost effective.			

5. Water Quality

Introduction

This section presents the overview of plans, programmes and baseline information for the appraisal of sustainability of the National Policy Statement for Geological Disposal Infrastructure and reasonable alternatives in respect of water quality and resources.

Water quality and resources within this context are defined as inland surface freshwater and groundwater resources, and inland surface freshwater, groundwater, estuarine, coastal and marine water quality.

There are links between water quality/resources and a number of other Appraisal of Sustainability (AoS) topics, in particular the effects and interactions of water quality and resources on biodiversity and human health and flood risk.

Review of Plans and Programmes

The *Water Framework Directive (WFD) (2000/60/EC)* provides the basis for the protection of water resources, with further EU directives providing legislation to ensure water quality. Together, the EU directives and domestic legislation aim ensure the maintenance or improvement of inland, coastal and groundwater quality, and that levels of pollution are reduced. Long term plans and policies have been produced to ensure that water resources can be maintained to cope with a future of increased demand and a changing climate. Plans are also either in place or being developed to effectively manage sustainable development in the marine area.

International/European

The ***Water Framework Directive (WFD) (2000/60/EC)*** is the most substantial piece of EC water legislation to date and replaced a number of existing Directives including the Surface Water Abstraction Directive. It establishes a framework for the protection of inland surface waters, transitional waters, coastal water and groundwater and is designed to improve and integrate the way water bodies are managed, including encouraging the sustainable use of water resources. The key objectives at the European level are general protection of the aquatic ecology, specific protection of unique and valuable habitats, protection of drinking water resources and protection of bathing water.

Article 4(1) of the WFD sets out that the objectives for surface water, groundwater, transitional and coastal water bodies are to:

- prevent deterioration;
- reduce pollution;
- protect, enhance and restore condition;
- achieve ‘good status’ by 2015, or an alternative objective where allowed; and
- comply with requirements for protected areas.

Article 7.3 of the Directive notes that Member States shall ensure the necessary protection for the bodies of water identified (for the purposes of providing human consumption for 50 persons or more, or providing more than $10m^3$ a day as an average and those bodies of water intended for such future use) with the aim of avoiding deterioration in their quality in order to reduce the level of purification treatment required in the production of drinking water. In addition, Member States may establish safeguard zones for those bodies of water.

The WFD adopted the 'polluter pays principle' in seeking to ensure that the costs and benefits of discharging pollutants to the water environment are appropriately valued, and that implementation of the Directive is achieved in a fair and proportionate way across all sectors.

The ***Groundwater Directive (2006/118/EC)*** established a regime which sets groundwater quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater. The Directive established quality criteria that takes account of local characteristics and allows for further improvements to be made based on monitoring data and new scientific knowledge. It is intended to complement the requirements of the WFD.

The ***Drinking Water Directive (DWD) (98/83/EC)*** concerns the quality of water intended for human consumption. The objective of the DWD is to protect the health of the consumers in the EU and to make sure the water is wholesome and clean. To do this, the DWD sets standards for 48 (microbiological and chemical) parameters that can be found in drinking water. The parameters must be monitored and tested regularly. Member States have to monitor the quality of the drinking water supplied to their citizens and of the water used in the food production industry. Member States report at three yearly intervals the monitoring results to the European Commission.

The ***Urban Waste Water Treatment Directive (91/271/EEC)*** has the objective of protecting the environment from the adverse effects of untreated 'urban waste water' ('sewage'). The Directive established minimum requirements for the treatment of significant sewage discharges. An important aspect of the Directive is the protection of the water environment from nutrients (specifically compounds of nitrogen and phosphorus) and/or nitrates present in waste water where these substances have adverse impacts on the ecology of the water environment or abstraction source waters. It was transposed into English law through the ***Urban Waste Water Treatment (England and Wales) Regulations 1994 (as amended) (SI 1994/2841).***

The ***Urban Waste Water Directive (98/15/EC)*** amended the ***Urban Waste Water Treatment Directive 91/271/EEC*** to clarify the requirements of the Directive in relation to discharges from urban waste water treatment plants to sensitive areas which are subject to eutrophication.

With specific regard to coastal water quality, the ***Bathing Waters Directive (2006/7/EC)*** sets standards for the quality of bathing waters in terms of:

- the physical, chemical and microbiological parameters;
- the mandatory limit values and indicative values for such parameters; and
- the minimum sampling frequency and method of analysis or inspection of such water.

The ***Marine Strategy Framework Directive (2008/56/EC)*** requires Member States to take the necessary measures to achieve or maintain good environmental status in the marine environment by 2020 at the latest through the development and implementation of marine strategies.

The OSPAR is the mechanism by which fifteen Governments of the western coasts and catchments of Europe, together with the European Community, cooperate to protect the

marine environment of the North-East Atlantic. A key document is ***The North-East Atlantic Environment Strategy of the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic 2010–2020*** which includes the Radioactive Substances strategy. This aims to prevent pollution of the OSPAR maritime area from ionising radiation. In particular, the OSPAR objective for 2020 is to reduce discharges, emissions and losses of radioactive substances to levels where the additional concentrations in the marine environment above historic levels, resulting from such discharges, emissions and losses, are close to zero.

In addition, the following European Directives have relevance to the protection of the water environment and resources:

- Directive on Priority Substances 2008/105/EC;
- Waste Framework Directive 2008/98/EC;
- Industrial Emissions Directive 2010/75/EU; and
- Directive 2013/51/Euratom laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption.

UK

The ***Flood and Water Management Act 2010*** makes provisions for water, including water resources, including:

- to widen the list of uses of water that water companies can control during periods of water shortage, and enable Government to add to and remove uses from the list;
- to encourage the uptake of sustainable drainage systems (SUDS) by removing the automatic right to connect to sewers and providing for unitary and county councils to adopt SUDS for new developments and redevelopments;
- to reduce 'bad debt' in the water industry by amending the Water Industry Act 1991 to provide a named customer and clarify who is responsible for paying the water bill; and
- to make it easier for water and sewerage companies to develop and implement social tariffs where companies consider there is a good cause to do so, and in light of guidance that will be issued by the Secretary of State following a full public consultation.

Shoreline Management Plans (SMPs), currently under revision by Coastal Groups and the Environment Agency, assess the risks to people, development and the natural and historic environment from coastal processes. These plans (SMPs) will provide a route map for local authorities for the time period of the next 20 years, and leading up to the next 50-100 years. They will include an action plan of what is required to manage coastal processes and where, and will form the basis of decision making for such works.

The Marine Strategy Framework Directive has been transposed into UK law through the ***Marine Strategy Regulations 2010*** (SI 2010/1627). It aims to achieve good environmental status of the EU's marine waters by 2021 and to protect the resource base upon which marine-related economic and social activities depend.

The ***Marine and Coastal Access Act 2009*** sets out a number of measures including the establishment of Marine Conservation Zones (MCZs) and Marine Spatial Plans. The main objectives of the ***Marine Policy Statement (2011)*** are to enable an appropriate and consistent

approach to marine planning across UK waters, and to ensure the sustainable use of marine resources and strategic management of marine activities from renewable energy to nature conservation, fishing, recreation and tourism.

The ***UK Strategy for Radioactive Discharges (2009)*** delivers the UK's obligations under the OSPAR Radioactive Substances Strategy, in respect of progressive and substantial reductions in radioactive discharges.

England and Wales

In England, the implementation work related to the WFD is undertaken by the Environment Agency, working with key partners. Natural Resources Wales undertakes the same duties for WFD implementation in Wales. There are 11 River Basin Districts in England and Wales which each require (under the WFD) a ***River Basin Management Plan (RBMP)*** including objectives for surface water, groundwater, transitional and coastal water bodies. Two districts are cross-border between England and Wales; for this reason, the majority of data and programmes regarding water quality and resources cover both administrations and therefore England and Wales are considered collectively in this context. Updated RBMPs were published in February 2016 for 8 river basin districts.

The 2011 White Paper, ***Water for Life***, sets out the Government's vision for future water management in which the water sector is resilient and water is valued as a precious resource. The key reforms set out in the White Paper are:

- the introduction of a reformed water abstraction regime, as signalled in the Natural Environment White Paper changes, to deal with the legacy of over-abstraction of our rivers;
- a new catchment approach to dealing with water quality and wider environmental issues;
- with the Environment Agency and Ofwat, provide clearer guidance to water companies on planning for the long term, and keeping demand down;
- consultation on the introduction of national standards and a new planning approval system for sustainable drainage; and
- collaboration with water companies, regulators and customers to raise awareness of the connection between how we use water and the quality of our rivers.

Water for people and the environment - Water resources strategy for England and Wales (2009) published by Environment Agency, includes the following objectives:

- enable habitats and species to adapt better to climate change;
- allow protection for the water environment to adjust flexibly to a changing climate;
- reduce pressure on the environment caused by water taken for human use;
- encourage options resilient to climate change to be chosen in the face of uncertainty;
- better protect vital water supply infrastructure;
- reduce greenhouse gas emissions from people using water, considering the whole life-cycle of use; and
- improve understanding of the risks and uncertainties of climate change.

Other relevant strategies include the Environment Agency's ***Catchment Abstraction Management Strategies*** (CAMS) which have identified a number of catchments in England and Wales that are designated as 'over-licensed' or 'over-abstracted'. That is, where the current level of licensed abstraction could result in an unacceptable stress on the catchment's ecology (designated over-licensed) or possibly is resulting in an unacceptable effect (designated over-abstracted).

The ***Water resources long term planning framework (2015-2065)*** seeks to develop a high-level strategy and framework for the long term planning of water resources for Public Water Supply in England and Wales. In turn, it provides an assessment of the key challenges facing public water supplies up to 50 years in future, in terms of the current planning process (water resource management plans and drought plans) and approaches used, and in particular, in terms of the levels of drought resilience that are planned, and how these differ across the country.

England

The ***Groundwater (Water Framework Directive) (England) Direction 2016*** sets out instructions to the Environment Agency on obligations to protect groundwater (water found below the surface). It updates requirements including:

- the monitoring and setting of thresholds for pollutants in groundwater;
- adding new pollutants to the list of pollutants to be monitored; and
- changing the information to be reported to the European Commission.

The ***Nitrate Pollution Prevention Regulations 2015*** provides for, among other issues, the designation of land as nitrate vulnerable zones.

The Marine Management Organisation (MMO) is responsible for preparing marine plans in England. The East Inshore and East Offshore marine plan areas were the first two to be selected in England. The ***East Inshore Marine Plan*** area covers 6,000 square kilometres of sea. It stretches from mean high water springs to 12 nautical miles offshore off the coastline between Flamborough Head and Felixstowe. The ***East Offshore Marine Plan*** area extends from the outer boundary of the East Inshore area to England's borders with the Netherlands, Belgium and France. This is a total of about 49,000 square kilometres of sea. The South Inshore and South Offshore areas are the third and fourth areas in England to be selected for marine planning.

The ***National Policy Statement for Waste Water (2012)*** sets out Government policy for the provision of major waste water infrastructure in England. It will be used by the decision maker as the primary basis for deciding development consent applications for waste water developments that fall within the definition of Nationally Significant Infrastructure Projects (NSIP) set out in the Planning Act 2008.

The ***National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2012)*** expects the planning system to contribute to conserving and enhancing the natural environment and reducing pollution. In particular, the planning system is expected to prevent new development from contributing to unacceptable levels of water pollution.

Local planning authorities are expected to set out the strategic priorities for their area in the Local Plan including strategic policies to deliver the provision of infrastructure for water supply and wastewater. In preparing the evidence base for their Local Plans, they are expected to work with other authorities and providers to assess the quality and capacity of the existing

infrastructure and its ability to meet forecast demands. Public bodies have a duty to co-operate on planning issues that cross administrative boundaries particularly those which relate to strategic priorities.

Planning Practice Guidance relating to water supply, wastewater and water quality provides advice on how planning can ensure water quality and the delivery of adequate water and wastewater infrastructure, which is needed to support sustainable development. It promotes a catchment based approach as set out by Defra in ***Catchment Based Approach: Improving the Quality of our Water Environment (2013)***, which provided the initial framework to bridge the gap between local actions and River Basin Management Plans.

The ***National Environment Programme*** published by the Environment Agency outlines improvements required to meet European Directives. It includes actions to improve the quality of water that is discharged from sewage treatment to either rivers or the sea, prevent chemicals from entering groundwater and ensure that abstraction of water does not adversely impact on habitats which are protected by law.

The ***Water Industry Act 1991 (as amended by the Water Act 2003)*** requires water undertakers to prepare and maintain Drought Plans under Section 39B and 39C of the Water Industry Act 1991. A drought plan is a plan for how the water undertaker will continue, during a period of drought, to discharge its duties to supply adequate quantities of wholesome water.

The Act also requires water undertakers to prepare and maintain a ***Water Resources Management Plan (WRMP)***. Fundamentally, WRMPs show how a water company will be able to provide a secure supply of water to customers over a 25-year period at an affordable price and without damaging the environment. WRMPs must take into account anticipated population growth, future housing, economic growth and climate change.

The ***UK Government response to consultation on reforming the Water Abstraction Management System (2016)*** sets out Defra's proposed plans for reforming the abstraction management system in England following extensive consultation. Key aspects of the reformed abstraction system include:

- abstraction permits that reflect current business use, with unused abstraction volumes removed subject to appeal;
- water storage will be permitted at any time flows are sufficiently high;
- all abstractors directly affecting surface water will have conditions on their permits that enable flow based controls to protect the environment; and
- a more efficient permit trading systems to allow abstractors to deal with low flows.

In response to the above proposals for revising the water abstraction system, the Environment Agency published ***Managing Water Abstraction (2016)***, which sets out how the Environment Agency will manage water resources in England. The Environment Agency also sets out its approach to balancing abstraction demands against the need to maintain desired ecology, particularly of surface water, through its ***Catchment Abstraction Management Strategies (CAMS)***.

Scotland

The ***Water Environment and Water Services (Scotland) Act 2003 (as amended)*** makes provisions for the protection of the Scottish water environment, including a timetable for implementation of requirements of the WFD up until 2015.

The ***Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended)*** (SSI 2011/209) sets out the process by which activities that have the potential to affect Scotland's water environment are regulated. Authorisation under the Controlled Activities Regulations (CAR) is required for discharging to waters, disposal of pollutants to land, abstractions, impoundments and engineering works affecting water bodies.

Scotland's ***National Marine Plan (NMP) (2015)*** is a single framework, enabling the sustainable development of Scotland's marine area in a way which will protect and enhance the marine environment whilst ensuring the sustainable growth of both existing and emerging marine industries.

The ***River Basin Management Plans for the Solway Tweed River Basin District and Scotland River Basin District (2015)*** seek to ensure that the water environment is protected, and where necessary and possible improved to good ecological condition in a pragmatic, and sensible way which balances human benefit with ecological impact.

Other relevant strategies include the Scottish Government's ***Bathing Water Strategy for Scotland (2006)*** which sets out a framework for meeting the challenges associated with implementing the revised Bathing Water Directive. This revision requires stricter bacteriological standards to be met in the future and sets new requirements for the provision of information on water quality to the public, as well as for engaging public participation in matters relating to bathing waters.

The Scottish Government's ***A Strategy for Scotland's Coast and Inshore Waters (2004)*** has goals that include (inter alia): delivering integrated management for the whole Scottish coast; establishing an integrated system of spatial planning for Scotland's inshore marine area which combines with the terrestrial planning system; strategic and adequately resourced leadership for the management and sustainable use of coastal resources; safeguard the resources of Scotland's coast and inshore waters and to promote awareness; and to achieve effective stakeholder participation at the appropriate geographical and administrative levels.

Policies aimed to provide a sustainable future for Scotland's groundwater resources by protecting legitimate uses of groundwater are included within the ***Groundwater Protection Policy for Scotland (2009).***

Scottish Planning Policy (2014) places a duty on the planning system to protect and improve the water environment, including rivers, lochs, estuaries, wetlands, coastal waters and groundwater, in a sustainable and co-ordinated way. ***Scotland's Third National Planning Framework (2014)*** sets out the importance of managing the water environment in a sustainable manner and the relevance of water within planning and the decision making process.

The Scottish Government provides advice in the form of Planning Advice Notes (PAN) on water and drainage including ***PAN 61: Planning and sustainable urban drainage systems*** and ***PAN 79: Water and drainage***.

Scotland's ***National Water Scarcity Plan*** sets out how water resources will be managed prior to and during periods of prolonged dry weather. This is to ensure the correct balance is struck between protecting the environment and providing resource for human and economic activity.

Wales

The ***Water Strategy for Wales (2015)*** sets out the strategic direction for water policy in Wales over the next 20 years and beyond. Water is one of the greatest natural assets and an integral part of Wales' culture, heritage and national identity. The Strategy highlights the Welsh Government's vision to ensure that Wales continues to have a thriving water environment

which is sustainably managed to support healthy communities, flourishing businesses and the environment. The aim is to ensure Wales has a more integrated and sustainable approach to managing water and associated services in Wales. The strategy will contribute to wider Welsh Government priorities and principles, including tackling poverty.

The ***Welsh National Marine Plan (WNMP)***, which covers Welsh inshore and offshore waters, is currently being developed. The Welsh Government is responsible for marine planning in Wales and marine planning will help to manage marine activities sustainably. The WNMP will have a 20 year outlook and provide important information and guidance to those who wish to use or undertake development in the marine area.

Within the ***Environment Strategy for Wales (2006)*** there are a number of water related objectives; including:

- to manage water resources sustainably without causing environmental damage;
- to increase water efficiency and maintain water quality;
- to maintain and enhance the quality of water sources; understand and manage diffuse pollution sources; and
- to minimise the risk posed by exposure to chemicals.

Planning Policy Wales (Edition 9) (2016) sets out the land use planning policies of the Welsh Government. Regarding water resources, Planning Policy Wales seeks to protect and improve water resources through increased efficiency and demand management of water, particularly in those areas where additional water resources may not be available, and ensure that appropriate sewerage facilities are provided to convey, treat and dispose of waste water in accordance with appropriate legislation and sustainability principles.

The ***Well-being of Future Generations (Wales) Act 2015*** became law in Wales on 29th April 2015 and strengthens existing governance arrangements for improving the well-being of Wales to ensure that present needs are met without compromising the ability of future generations to meet their own needs. This act is supported by the ***Planning (Wales) Act (2015)*** and ***Environment (Wales) Act 2016***.

The ***Environment (Wales) Act 2016*** recognises that natural resources, such as water, are amongst the most important assets. The Act includes features that will ensure that managing these natural resources sustainably will be a core consideration in decision-making, including providing for targets for reducing emissions of greenhouse gases. It also established the Flood and Coastal Erosion Committee and made minor changes to the law about land drainage.

Overview of the Baseline

UK

The UK has a diversity of inland and coastal waters (such as reservoirs, lakes, rivers, canals, estuaries, transitional waters and coastal waters). Protected water features include: waters designated for human consumption (including those abstracted from groundwater); areas designated for the protection of economically significant aquatic species (e.g. shellfish or freshwater fish); bathing waters (under the Bathing Waters Directive); nutrient-sensitive areas; and areas with waters important to protected habitats or species under the Habitats Directive or the Birds Directive.

There are 189 protected areas in UK inshore waters with a marine element, which includes 102 Special Protection Areas (SPAs) with marine habitats for birds[189], 105 Special Areas of Conservation (SACs) with marine habitats or species[190], 56 Marine Conservation Zones, 30 Nature Conservation Marine Protected Areas[191] and three Marine Nature Reserves. In total, the area coverage of these sites exceeds 1.5 million hectares, or 1.8% of UK waters.

The principal aquifers of the UK are located in the lowlands of England. The most important are the Chalk, Permo-Triassic sandstones, the Jurassic limestones and the Lower Greensand.

Figure 5.1 shows the status classification of all UK surface water bodies under the Water Framework Directive. There was a decrease in the overall number of water bodies in the UK awarded high or good surface water status between 2011 and 2016. In 2011, 37% of surface water bodies were assessed as being in high or good status, falling to 35% in 2016[192].

[189] Joint Nature Conservation Committee (2017) *SPAs with marine components*. Available online at: http://jncc.defra.gov.uk/page-4559
[190] Joint Nature Conservation Committee (2017) *SACs with marine components*. Available online at: http://jncc.defra.gov.uk/page-1445
[191] Joint Nature Conservation Committee (2017) *Contributing to a marine protected area network*. Available online at: http://jncc.defra.gov.uk/page-4549
[192] Joint Nature Conservation Committee (2017) *Surface water status*. Available online at: http://jncc.defra.gov.uk/page-4250

Figure 5.1 Status classification of UK surface water bodies under the Water Framework Directive, 2009 to 2016

Source: Joint Nature Conservation Council

England

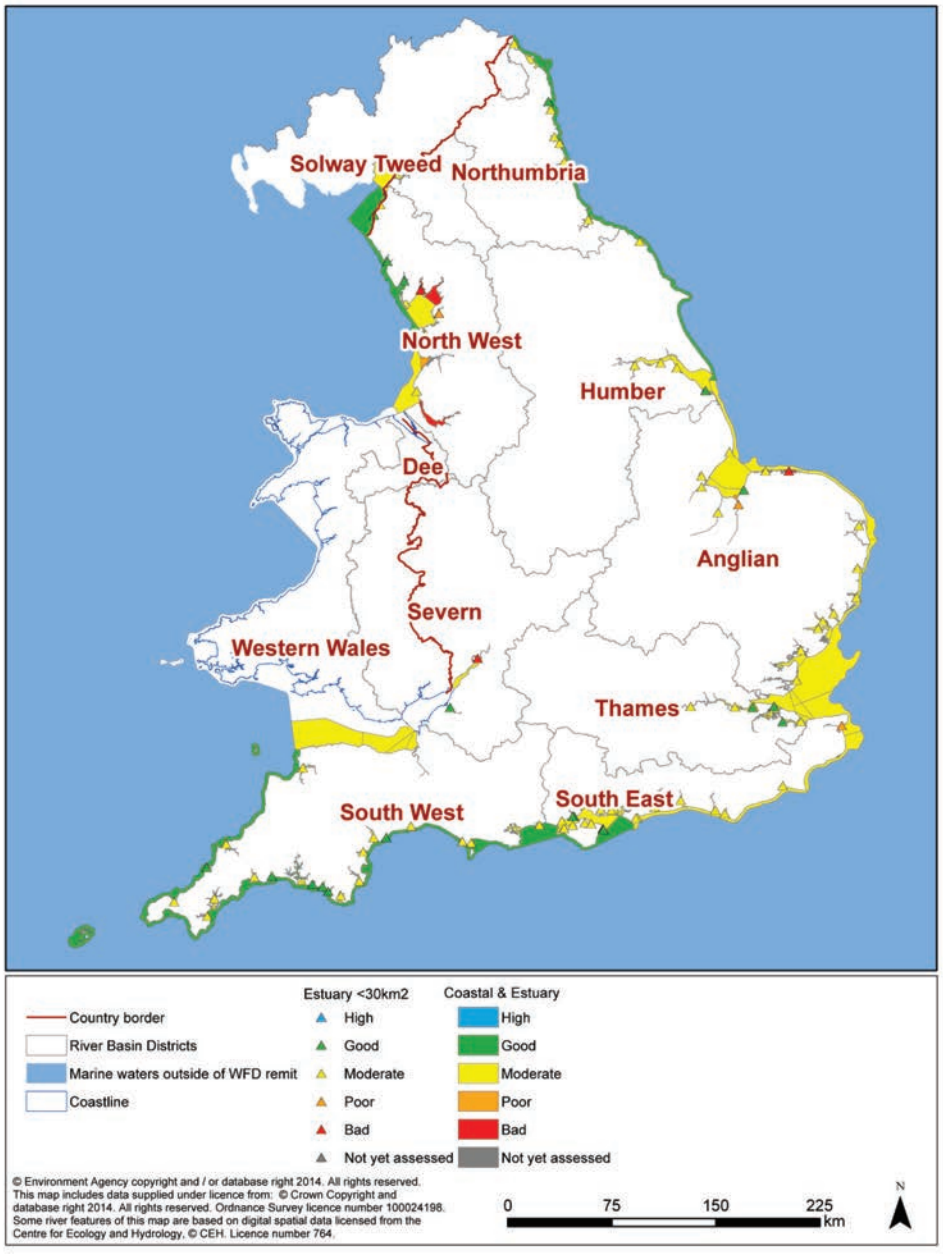
Water Quality

There are 8 river basin management areas in England, each of which covers an entire river system, including river, lake, groundwater, estuarine and coastal water bodies. River water quality in England has in general been steadily increasing since 1990. The proportion of rivers at good or high biological quality did not change significantly between 2009 and 2012 but decreased slightly in 2013 and 2014[193].

Coastal water quality has improved over the last two decades, however current WFD draft classification results and maps produced by the Environment Agency indicate that there are still a large proportion of coastal waters in England (and Wales) that are classified as being of Moderate Ecological Status (see **Figure 5.2**), i.e. are failing to meet 'Good Ecological Status' (GES) on the basis of a number of physio-chemical and biological standards and are therefore in need of measures to achieve GES.

[193] Office for National Statistics (2015) *Sustainable Development Indicators*. Available online at: http://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/articles/sustainabledevelopmentindicators/2015-07-13

Figure 5.2 Ecological Status or Potential for Estuaries and Coastal Water Bodies in England and Wales



Source: Environment Agency (2014) *Estuarine and coastal waters national engagement summary*. Available online at: http://auneconservation.org.uk/wp-content/uploads/2014/12/Estuarine_and_coastal_waters.pdf

Groundwater provides a third of drinking water in England, and up to 80% in some areas of southern England. The Environment Agency has defined Source Protection Zones (SPZs) for 2,000 groundwater sources. These zones show the risk of contamination from any activities that might cause pollution in the area. The Environment Agency use the zones in conjunction with their Groundwater Protection Policy to set up pollution prevention measures in areas which are at a higher risk and to monitor the activities of potential polluters nearby.

Groundwater Source Protection Zones are classified as either 'Inner Zone' (Zone 1), 'Outer Zone' (Zone 2), 'Total Catchment/Source Catchment' (Zone 3) or 'Special Interest' (Zone 4).

The shape and size of a zone depends on the condition of the ground, how the groundwater is removed, and other environmental factors[194].

In terms of radioactive discharges to water, the Nuclear Sector Plan: 2015 Environmental Performance Report[195] highlights that:

- Total dose-weighted discharges to water by the whole nuclear sector fell by 6.8% in 2015 compared to 2014. Discharges by all sub-sectors declined, except for the electricity generation sub-sector, where discharges increased by 0.1% as a result of increased electricity production.
- Carbon-14 discharges by the fuel reprocessing sub-sector dominate the discharges, and were responsible for 93% of all dose-weighted discharges in 2015. Discharges are related to throughput at the Magnox fuel reprocessing plant.
- Discharges to water fluctuate year-on-year depending on projects and programmes of work being implemented across the diverse sub-sectors of the industry.

Water Resources

The abstraction of water from non-tidal surface water and groundwater in England and Wales had fallen steadily from the peak of an estimated 11.6 billion cubic metres in 2001 to 8.2 billion cubic metres in 2011. However, since 2011, total abstraction has increased by 14% to 9.4 billion cubic metres, driven mostly by abstraction for electricity generation, which increased from 1.4 billion cubic metres in 2011 to 2.5 billion cubic metres in 2015. This is in contrast to the statistics for 2016 which showed that abstraction was decreasing due to a large reduction in hydropower abstracted in Wales. The abstractions for public water supply, which makes up 50% of total abstraction, decreased slightly by 1% over the same period to 5.1 billion cubic metres in 2015[196].

The results from the first cycle of Catchment Abstraction Management Strategies in 2008 showed that there is considerable pressure on water resources throughout England and Wales but in particular in the South East and East of England, with less pressure in the north west of England and the west of Wales (see **Figure 5.3** below)[197].

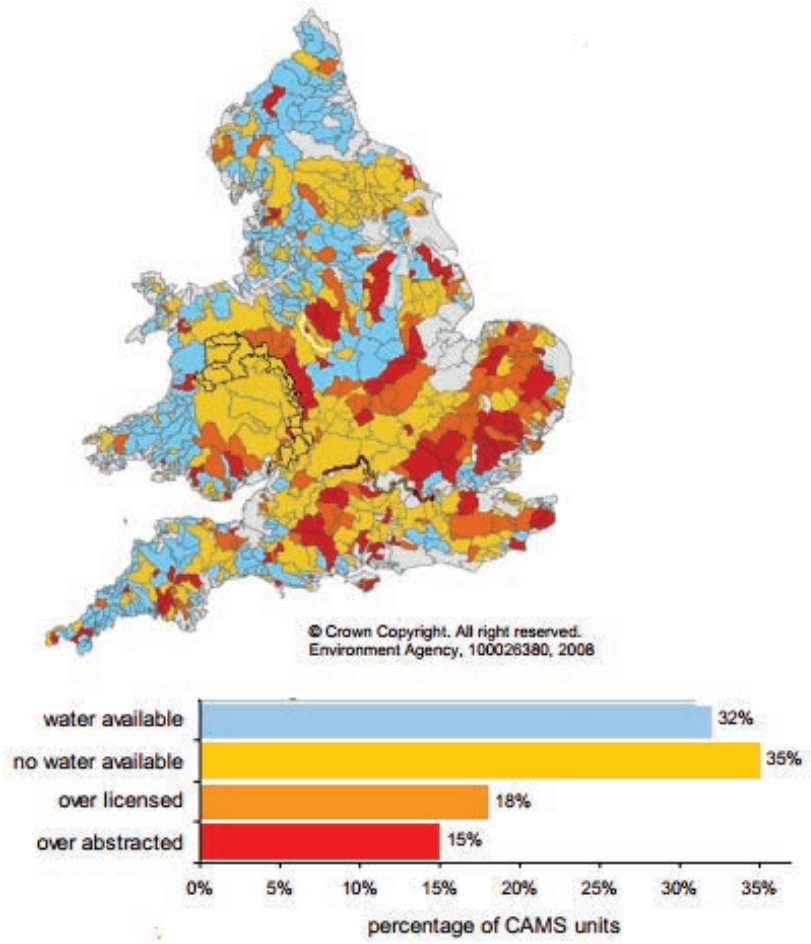
[194] A map that shows the contours of these zones for England and Wales can be viewed on the Environment Agency's website at: http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=groundwater.

[195] Environment Agency & Natural Resources Wales (2016) *Nuclear Sector Plan: 2015 Environmental Performance Report*. Available online at: https://www.gov.uk/government/publications/nuclear-industry-environmental-performance-reports

[196] Defra (2017) *Water abstraction statistics, England 2000-2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/422246/Water_Abstractions_release_V1.pdf

[197] Defra (2013) *Environmental Statistics – Key facts*. Available online at: http://data.defra.gov.uk/env/doc/Environmental%20Statistics%20key%20facts%202012.pdf

Figure 5.3 Map of Water Available for Abstraction (surface water combined with groundwater)



Source: Environment Agency (2008) *Water resources in England and Wales – current state and future pressures*. Available online at: http://webarchive.nationalarchives.gov.uk/20140328084622/http:/cdn.environment-agency.gov.uk/geho1208bpas-e-e.pdf

Water use in the nuclear industry decreased each year between 2005 and 2008, but has remained relatively stable since then. In 2015, 13,197,000m^3 of water was consumed, an increase of 2.9% against 2014 due to operational demands at sites in the defence sub-sector and fuel reprocessing sector. The electricity generation sub-sector used 1.5% less water. The waste management sub-sector also achieved a 74% reduction in water used due to plant closure for refurbishment[198].

Bathing Water

In 2016, 98.5% of bathing waters met the minimum standard of the Bathing Water Directive, with 69.5% reaching the excellent standard. A total of 6 bathing waters, representing 1.5% of the total, did not meet the minimum requirement. Due to a change in recording methodology, bathing water quality statistics can only be compared to statistics from the year 2015 onwards.

[198] Environment Agency & Natural Resources Wales (2016) *Nuclear Sector Plan: 2015 Environmental Performance Report*. Available online at: https://www.gov.uk/government/publications/nuclear-industry-environmental-performance-reports

The data for 2016 showed an improvement on the data from 2015 as a result of recent improvements to infrastructure and more favourable weather conditions[199].

Scotland

Water Quality

Overall, Scotland's water environment is in a good condition but a wide range of problems exist at local levels. In most cases, the risks to water quality are declining, the exception being groundwater.

Scotland has two river basin districts: the Scotland river basin district which covers most of Scotland and the Solway Tweed river basin district in the south of the country. The Scotland river basin district has been sub-divided into eight Management Plan Areas which are administrated by eight regional 'Area Advisory Groups' (AAGs). These are: Argyll; Clyde; Forth; North East Scotland; North Highland; Orkney and Shetland; Tay and West Highland.

Table 5.1 displays the percentage of water bodies in each class in Scotland for 2015[200]. Overall, 63% of groundwater and surface water bodies were at high or good status.

Table 5.1 WFD Classification Results for Water Bodies in Scotland: Number of Water Bodies in each Class 2015

Status Category	High	Good	Moderate	Poor	Bad
River	167	1,147	582	385	126
Lake	104	108	79	40	3
Transitional	14	28	7	-	-
Coastal Waters	157	269	30	1	-
Groundwater	-	319	-	84	-

Source: SEPA. *Water Classification Hub.* Available online at: https://www.sepa.org.uk/data-visualisation/water-classification-hub/

Water Resources

Between 2002 and 2009, estimated raw water abstractions by Scottish Water decreased by 13% to 2,165 Ml/d. Between 2010 and 2015, using improved data and methodology, the volume of raw water abstracted decreased by 12.6% to 1,831 Ml/d[201].

[199] Defra (2016) *Statistics on English coastal and inland bathing waters: a summary of compliance with the 2006 Bathing Water Directive*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/565710/STATS_bathing-water-release-2016v1.pdf

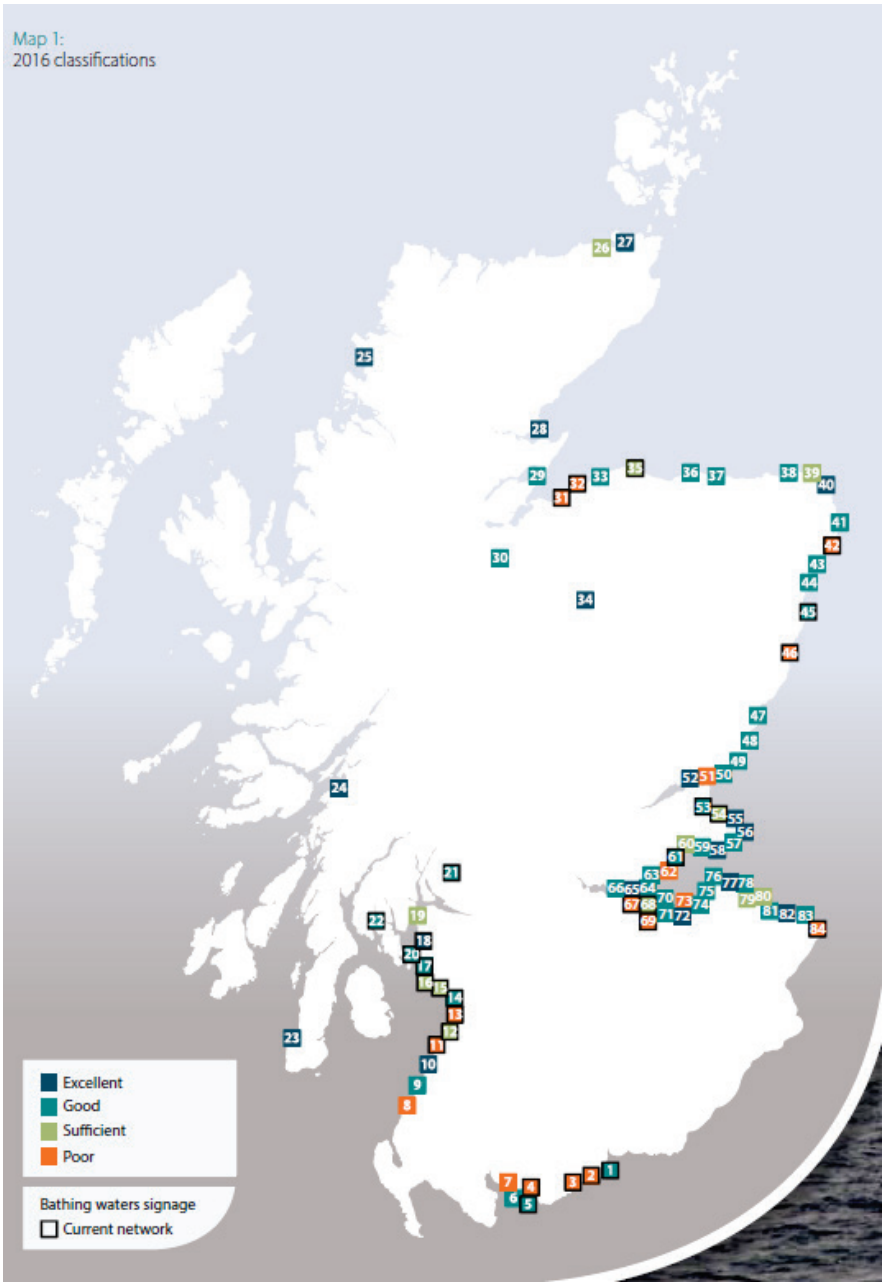
[200] Scottish Environment Protection Agency (2017) *Water Classification Hub*. Available online at: https://www.sepa.org.uk/data-visualisation/water-classification-hub/

[201] Scottish Government (2016) *Public Water Supplies – Water Abstracted and Supplied*. Available online at: http://www.gov.scot/Publications/2013/08/1634/26

Bathing Water

In 2016, 80% of Scottish bathing waters had at least sufficient or better classification against the new, more stringent water quality standards, and 65% of bathing waters had an excellent or good classification. The remaining 20% were classified as poor[202]. **Figure 5.4** shows the bathing water classifications across Scotland for 2016.

Figure 5.4 Map of Bathing Water Results 2016 in Scotland



Source: SEPA. Scottish Bathing Waters 2016. Available online at: https://www.sepa.org.uk/media/219168/1282_sepa_bathing_waters_2016_web.pdf

[202] Scottish Environmental Protection Agency (2016) *Scottish Bathing Waters 2016*. Available online at: https://www.sepa.org.uk/media/219168/1282_sepa_bathing_waters_2016_web.pdf

Wales

Water Quality

The Welsh Government reported on the River Basin Planning progress in 2015 and **Table 5.2** shows the percentage of water bodies in each River Basin District achieving poor, moderate or good status, both in 2009 and 2015[203].

Table 5.2 Overall status of water bodies in Wales as a percentage between 2009 and 2015

River Basin District	2009			2015		
	Poor	Moderate	Good	Poor	Moderate	Good
Dee	11	58	30	5	63	31
Western Wales	7	63	30	5	57	38
Welsh part of the Severn River	12	50	37	8	47	43

In 2009, 10% of all water bodies were in poor condition, 57% were in moderate condition and 33% were in good condition. The 2015 classification shows that the percentage of water bodies achieving good or better status has increased to 38%. The number of water bodies at poor status, meanwhile, has reduced to 6% with a resulting increase in the number of water bodies at moderate status.

The 2015 classification results indicate that 39% of surface water bodies achieved good or better status. All 38 groundwater bodies in Wales achieved good quantitative status in 2015. For chemical status, in 2015 22 groundwater bodies met good chemical status in Wales, a reduction of four compared to 2009.

The main reasons for water body failure in Wales are pollution from abandoned mines and contaminated land, agricultural pollution, barriers to fish migration and impoundments. Sewage discharges, acidification, forestry, flood protection and land drainage, surface water drainage from urban and transport development, abstraction and industrial discharges are also factors.

The 'Wales' Marine Evidence Report' (2015) highlights that no transitional or coastal water bodies in Wales fail the assessment of chemical status, based on priority hazardous substances defined in the WFD. However, in numerous instances, ecological status /potential has not been reported as good[204].

[203] Welsh Government (2015) *River Basin Planning Progress Report for Wales 2009-2015*. Available online at: http://naturalresources.wales/media/676155/progress-report-for-wales-2009-2015-english.pdf
[204] Welsh Government (2015) *Wales' Marine Evidence Report.* Available online at: http://gov.wales/topics/environmentcountryside/marineandfisheries/marine-planning/other-supporting-evidence/wales-marine-evidence-report/?lang=en

Water Resources

In Wales, water is abstracted from water bodies for many purposes, including public water supply in Wales and England, agriculture, industry and electricity generation. Most of the water licensed for abstraction is from surface water rather than groundwater, with electricity generation being the sector abstracting the most (82%), followed by public water supply (13%), other industry (0.03%), fish farming and amenity ponds (0.01%). Spray irrigation, other agriculture and private water supplies account for a very low percentage of the total water abstracted[205].

About 60% of water bodies in Wales can provide a reliable source of water for new abstractions at least 95% of the time. Approximately 10% of water bodies in Wales can only provide water for new abstractions 30% or less of the time (less than 100 days a year)[206].

Some of the water used to supply densely populated areas is taken from water bodies in statutory designated protected areas. Changes to hydraulic conditions are identified as having an impact or likely to have an impact on 45 of 112 (40%) Natura 2000 protected sites. Reduced flows caused by abstraction present risks to migratory fish and wider biodiversity. Water Framework Directive (WFD) investigations have identified 29 (3%) water bodies that have failed to meet objectives because of changes to flows and water levels[207].

Bathing Water

In 2016, 102 of the 103 designated Welsh bathing waters met the standards set by the Bathing Water Directive. Of the 103 bathing waters assessed, 84 were of an excellent standard, 13 achieved a good standard and 5 achieved sufficient standard. One Welsh bathing water failed to comply with the Directive standards and was classified as poor. Two more Bathing Waters achieved an excellent classification compared with the results in 2015[208].

Summary of Existing Problems Relevant to the Geological Disposal NPS

The following existing problems for water quality and resources have been identified:

- There is considerable pressure on water resources in many parts of the UK, which can in turn affect water quality.
- Demand for water is expected to increase from an increasing population alongside industrial, agricultural and commercial pressures.
- Climate change is expected to have significant impacts on the water environment. Areas where the underlying geology is generally impermeable are expected to be particularly affected as river flows would be likely to fall to low levels in drier periods and quickly react to rainfall episodes.

[205] Environment Agency (2011) *Case for change – current and future water availability*. Available online at: http://webarchive.nationalarchives.gov.uk/20140328084622/http:/www.environment-agency.gov.uk/research/planning/135501.aspx
[206] Environment Agency & NRW (2013) *Current and future water availability – addendum: A refresh of the Case for Change analysis, December 2013*. Available online at: http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/research/planning/135501.aspx
[207] Natural Resources Wales (2016) *The State of Natural Resources Report (SoNaRR): Assessment of the Sustainable Management of Natural Resources*. Available online at: https://naturalresources.wales/media/681127/chapter-3-state-and-trends-final-for-publication.pdf
[208] Natural Resources Wales (2017) *Bathing Waters in Wales 2016*. Available online at: https://naturalresources.wales/media/681414/wales-bathing-water-report-2016.pdf

- There is a need to ensure that there is sufficient water infrastructure in place to accommodate future growth in the UK.
- There is a legacy of groundwater pollution in the UK from historical mining and other industrial activities, although this is being progressively addressed as sites are remediated as part of site redevelopment.
- Many waterbodies are subject to pressure from multiple sources including rural diffuse pollution, waste water discharges, acidification and urban diffuse pollution.

Likely Evolution of the Baseline

UK

Water Quality

Future projections under the UK Climate Change Risk Assessment[209] for an increased incidence of warmer, drier summers are very likely to increase the risk of low flows and reduced water levels. In combination with higher water temperatures, this increases the risk of ecosystem disruption from reduced oxygen supply, thermal stress to species, reduced dilution of harmful pollutants and increased incidence of algal blooms in water bodies. Climate change would therefore provide further stress for water bodies that do not have good ecological status and may introduce new risks for water bodies that do have good status, depending on the magnitude of change. Impacts would be exacerbated during periods of drought, although currently evidence for increased incidence of drought remains limited.

The increased likelihood of more frequent periods of heavy rainfall could cause further raw water quality problems due to increased runoff/discharge of pollutants, effluents and sediments into water bodies, including elevated levels of dissolved organic carbon.

Risks may be further exacerbated in some catchments due to shifts towards more intensive land use, contributing greater pollution loads from diffuse sources. Depending on the rate of sea-level rise, existing freshwater aquifers may be at an increased risk of saline intrusion, with implications for drinking water supplies.

Ecosystems, particularly wetlands and woodlands, regulate and filter the flow of water through vegetation and soils. Climate related and human-related changes to ecosystems will therefore modify their role in buffering against extreme high flows (flood risk) and low flows, in addition to their role in water circulation and purification[210].

In the UK, 96.8% of bathing waters met the mandatory water quality in 2016. Between 2015 and 2016, 16 UK sites improved from poor to sufficient[211]. It is anticipated that the overall quality of bathing waters is likely to increase as water quality is improved to meet the requirements of the Bathing Water Directive.

[209] UK CCC ASC (2016) *UK Climate Change Risk Assessment 2017: CCRA2 Evidence Report*. Available online at: https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/
[210] UK Committee on Climate Change (2017) *UK Climate Change Risk Assessment 2017*. Available online at: https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/ccra-chapters/natural-environment-and-natural-assets/
[211] European Environment Agency (2016) *State of Bathing Water*. Available online at: https://www.eea.europa.eu/themes/water/status-and-monitoring/state-of-bathing-water

Water Resources

It is anticipated that climate change will affect river flows, and in turn the availability of water, in the following ways:

- increases in average winter flows;
- reduced summer flows;
- reduced spring flows;
- no clear pattern in autumn flows; and
- increases in the magnitude of flood events.

The increasingly seasonal rainfall patterns will lead to lower summer river flows, especially in those catchments with a low groundwater component. This could lead to increased abstraction pressure and reduced water availability over the summer months. Population pressures are predicted to increase in certain parts of Great Britain, for example in the South East[212]. Increased population density will result in an increased pressure on natural resources and could exacerbate current problems or cause new ones. Economic growth could also lead to increased commercial, industrial and agricultural pressure on water resources[213].

England

The Environment Agency's Catchment Abstraction Management Strategies (CAMS) have identified a number of catchments in England which are designated as Over-Licensed or Over-Abstracted. Climate change is likely to result in lower summer rainfalls and more frequent/severe winter flood events. Such changes are likely to increase pressure on summer freshwater water availability and increase pollutant run-off into controlled waters during flood events. Unsustainable groundwater and surface water abstraction may contribute to environmental damage of rivers and wetlands at 500 sites in England and Wales, important conservation sites, including sites of national and international conservation importance. However, it should be noted that the Environment Agency's approach to abstraction management and the restrictions placed on abstraction by the Water Framework Directive would both be expected to act in mitigation of these potential trends.

The objectives of the RBMPs, required by the WFD and referenced earlier in this section, are:

- to prevent deterioration of the status of surface waters and groundwater;
- to achieve objectives and standards for protected areas;
- to aim to achieve good status for all water bodies or, for heavily modified water bodies and artificial water bodies, good ecological potential and good surface water chemical status;
- to reverse any significant and sustained upward trends in pollutant concentrations in groundwater;

[212] ONS (2016) *Subnational Population Projections for Local Authorities in England: Table 2*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/localauthoritiesinenglandtable2

[213] Anglian Water, United Utilities and Yorkshire Water (2015) Water 2020 – Long term challenges and uncertainties for the water sector of the future. Available online at: http://www.anglianwater.co.uk/_assets/media/Water_2020_LT_Challenges_-_Final.pdf

- the cessation of discharges, emissions and loses of priority hazardous substances into surface waters; and
- progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants.

Since a new assessment framework was introduced in 2009, there has been no real change in the quality of rivers within England; between 2009 and 2012 the percentage of rivers of good biological quality in England dropped from 26% to 25%. Over the same time period the percentage of rivers that passed the chemical status criteria rose from 78% to 80%.

Defra aims that by 2030, at the latest, England will have improved the quality of our water environment and the ecology which it supports, and continue to provide high levels of drinking water quality from its taps; sustainably manage risks from flooding and coastal erosion, with greater understanding and more effective management of surface water; ensure a sustainable use of water resources, and implement fair, affordable and cost reflective water charges; cut greenhouse gas emissions; and embed continuous adaptation to climate change and other pressures across the water industry and water users.

Scotland

Table 5.3 demonstrates that the overall percentage of water bodies in Scotland which were at good or high status in 2007 and 2015 was broadly similar for most water categories, with transitional waters showing the most notable rise. In most cases the risks to water quality are steady or declining.

Table 5.3 WFD Classification Results for Water Bodies in Scotland; Percentage of Water Bodies in each Class for 2007 and 2015

Status Category	High	Good	Moderate	Poor	Bad
Rivers (2007 Classification)	8	40	31	16	5
Rivers (2015 Classification)	7	48	24	16	5
Lakes (2007 Classification)	26	35	15	22	2
Lakes (2015 Classification)	31	32	24	12	1
Transitional (2007 Classification)	28	16	44	4	8
Transitional (2015 Classification)	29	57	14	0	0
Coastal Waters (2007	57	34	9	0	0

Status Category	High	Good	Moderate	Poor	Bad
Classification)					
Coastal Waters (2015 Classification)	34	59	7	0	0
Groundwater (2007 Classification)	-	76	-	24	0
Groundwater (2015 Classification)	-	79	-	24	-

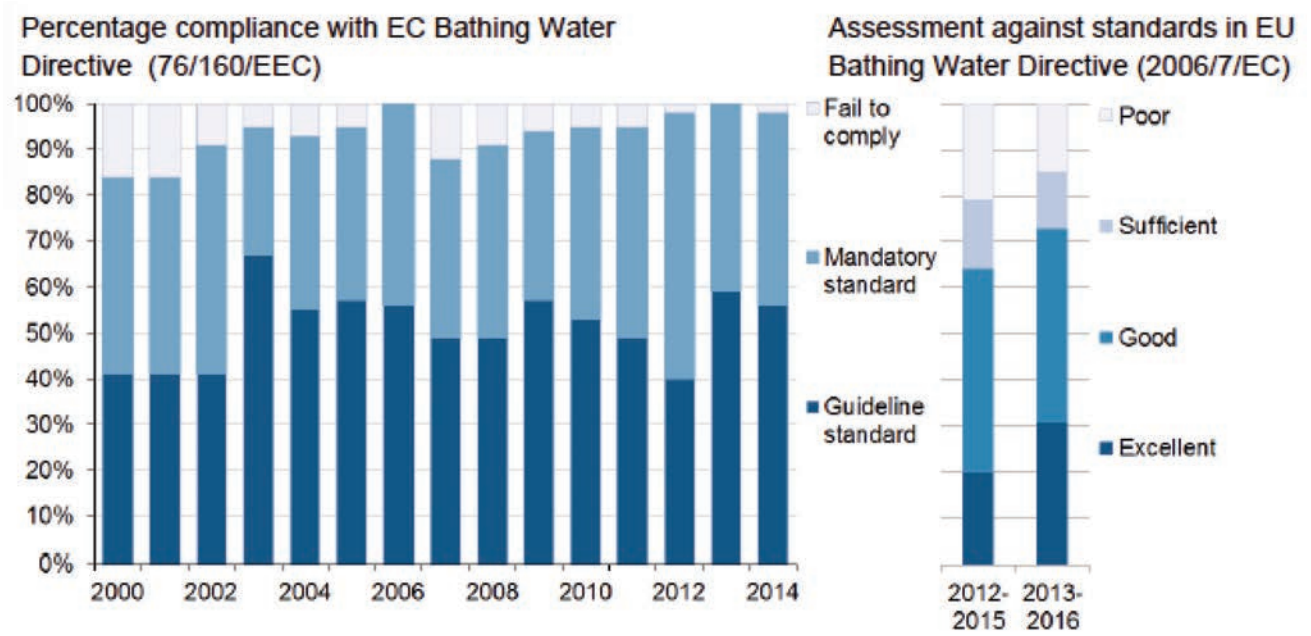
Another important trend is the sources of effects. In general, environmental effects from industry are declining, although effects from historic activities are still causing pressure on the water environment, whereas effects from urban development and agriculture are ongoing[214].

The Scotland river basin district objective is to improve water quality such that 88% of water bodies will be of good or better condition by 2027[215]. By 2027, the objective for the Solway Tweed river basin district is for 90% of water bodies to be of good or better quality[216].

As illustrated in **Figure 5.5** below, there was a steady improvement in compliance with the mandatory standard between 2007 and 2013 when all coastal bathing waters met the mandatory standard. There has been an increase in the number of coastal bathing waters assessed as excellent quality from 16 over the four years to 2015, to 25 over the four years to 2016. The number assessed as poor quality fell from 17 over the four years to 2015, to 12 over the four years to 2016. Weather can have a large effect on the compliance of bathing waters, as heavy rain can lead to overflows from drains and surface water run-off from fields containing animal manure, which raises the risk of sites failing to meet the required standard.

Figure 5.5 Percentage Compliance of Coastal Waters with the EC Bathing Water Directive 2000 - 2016

[214] Scotland's Environment Web Partnership (2014) *Scotland's State of the Environment Report, 2014*. Available online at: http://www.environment.scotland.gov.uk/media/92572/state-of-environment-report-2014.pdf
[215] Scottish Government (2015) *The river basin management plan for the Scotland river basin district 2015–2027*. Available online at: https://www.sepa.org.uk/media/163445/the-river-basin-management-plan-for-the-scotland-river-basin-district-2015-2027.pdf
[216] Scottish Government and Environment Agency (2015) *The river basin management plan for the Solway Tweed river basin district: 2015 update*. Available online at: https://www.sepa.org.uk/media/218890/rbmp_solway_tweed_2015.pdf



Source: Scottish Government (2016) *Key Scottish Environmental Statistics 2016: Water*. http://www.gov.scot/Publications/2016/10/7565/334167

Climate change is likely to bring uncertainty and, with a projected decrease in summer rainfall, may exert pressure in areas that have not yet experienced water scarcity. Climate change may also reduce the ability of the water environment to safely absorb and break down pollutants. In addition, the likelihood of reduced summer rainfall may mean less water for diluting pollutants, while conversely, expected higher annual river flows at some times of the year may help dilute pollutant discharges to rivers. The quantity of pollutants reaching the sea without first having been broken down in rivers may therefore increase. Groundwater is also a valuable resource in Scotland providing water to households and small businesses, and maintaining base river flows in summer months. Groundwater recharge is vulnerable to drier summer conditions[217].

Wales

Wales records some of the highest rainfall levels in the UK, and relies on this rainfall which is collected in the rivers, lakes and reservoirs as sources of water supply. However, in significant parts of Wales, there are no further reliable supplies of water available for new abstractions. Whilst population increase estimates are lower for Wales than for many other parts of the UK, growth will place further pressure on water resources.

Under the WFD, rivers in England and Wales were required to have achieved 'good ecological status' by 2015. Where this was not possible and subject to criteria set out in the Directive, the aim is to achieve good status by 2021 or 2027. The second River Basin Management Plan cycle, 2015 – 2021 recognises the large degree of uncertainty about achieving such significant increases to achieve good status or better by 2021. NRW propose in Wales to improve compliance with good status by delivering measures locally in an integrated way to achieve

[217] Scottish Government (2013) *Climate Ready Scotland: Strategic Environmental Assessment*. Available online at: http://www.gov.scot/Resource/0042/00426535.pdf

improvements. This will involve targeting 21 water bodies in the Western Wales River Basin District[218] and seven in the Dee River Basin District[219].

Climate change is expected to have significant effects on river flows in Wales, with most major watercourses experiencing a 10-15% increase in mean monthly winter flows and 50-80% decreases in summer flows.

The State of Natural Resources Report (SoNaRR)[220] highlights that climate change may affect groundwater recharge in Wales and that by 2025, it is likely that groundwater recharge will decrease, resulting in decreased dry weather river flows and a general lowering of groundwater levels. This may have impacts on base-flow to rivers and wetlands in dry periods and affect small domestic and agricultural water supplies.

Assessing Significance

The objectives and guide questions related to water quality and resources which have been identified for use in the appraisal of the effects of Geological Disposal Infrastructure NPS proposals are set out in **Table 5.4**, together with reasons for their selection.

Table 5.4 Approach to Assessing the Effects of the Geological Disposal Infrastructure NPS Proposals on Water Quality

Objective/Guide Question	Reasoning
Objective: To maximise water efficiency, protect and enhance water quality and help achieve the objectives of the Water Framework Directive.	The SEA Directive (2001/42/EC) requires that likely significant effects on water be taken into account in the Environmental Report, which for the purposes of the AoS is incorporated within the AoS Report.
Will the Geological Disposal Infrastructure NPS affect demand for water resources?	The Water Framework Directive (2000/60/EC) encourages the sustainable use of water resources. Government strategies including Water for people and the environment - Water resources strategy for England and Wales (2009) and Water for Life (2011) promote the sustainable use of water. Some parts of the UK have abstraction above a sustainable level which could result in water shortages in some areas in the future. Demand for water is also expected to increase from a growing population alongside industrial, agricultural and commercial pressures.

[218] Natural Resources Wales (2015) *Western Wales River Basin Management Plan 2015 – 2021 Summary*. Available online at: https://naturalresources.wales/media/676165/wwrbdsummary.pdf
[219] Natural Resources Wales (2015) *Dee River Basin Management Plan 2015 – 2021 Summary*. Available online at: https://naturalresources.wales/media/674606/deerbdsummary.pdf
[220] Natural Resources Wales (2016) *The State of Natural Resources Report (SoNaRR)*. Available online at: https://naturalresources.wales/evidence-and-data/research-and-reports/the-state-of-natural-resources-report-assessment-of-the-sustainable-management-of-natural-resources/?lang=en

Objective/Guide Question	Reasoning
Will the Geological Disposal Infrastructure NPS affect the amount of waste water and surface run-off produced?	Surface run-off and waste water may affect water quality if it reaches water receptors. The Water Framework Directive (2000/60/EC) requires all inland, coastal and groundwater to reach a 'good' chemical and ecological status.
Will the Geological Disposal Infrastructure NPS protect and enhance the quality of surface, groundwater, estuarine and coastal water quality?	The Water Framework Directive (2000/60/EC) requires all inland, coastal and groundwater to reach a 'good' chemical and ecological status. Government strategies such as the Water resources strategy for England and Wales (2009) and Water for Life (2011) include objectives to protect the quality of water.

Table 5.5 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the population objective.

Table 5.5 Illustrative Guidance for the Assessment of Significance for Water Quality

Effect	Description	Illustrative Guidance
++	Significant Positive	• Option would lead to a major reduction in water use compared to prior to development such that the risk of water shortages in an area is significantly decreased and abstraction is at a sustainable level in the long term; • Option would significantly decrease the amount of waste water, surface run-off and pollutant discharges so that the quality of water receptors (including groundwater, surface water, sea water or drinking receptors) would be significantly improved and sustained and water targets (including those relevant to chemical and ecological condition) reached and exceeded.
+	Positive	• Option would lead to a minor reduction in water use compared to prior to development such that the risk of water shortages in an area is decreased in the short term and abstraction is closer to sustainable levels than prior to development; • Option would lead to minor decreases in the amount of waste water, surface run-off and/or pollutant discharges so that the quality of water receptors (including groundwater, surface water, sea water or drinking receptors) may be improved to some level temporarily and some water targets (including those relevant to chemical and ecological condition) would be reached/exceeded.
0	Neutral	• Option would not significantly affect water demand and abstraction levels would not be altered; • Option would not change the amount of waste water, surface run-off and/or pollutant discharges such that the quality of water receptors would not be affected.
-	Negative	• Option would lead to a minor increase in water use compared to prior to development such that the risk of water shortages in an area is increased to some level in the short term, particularly in periods of low flow, and abstraction is considered beyond sustainable levels; • Option would lead to minor increases in the amount of waste water, surface run-off and/or pollutant discharges so that the quality of water receptors (including groundwater, surface water, sea water or drinking

Effect	Description	Illustrative Guidance
		receptors) may be decreased to some level temporarily and it may prevent some water targets (including those relevant to chemical and ecological condition) from being achieved.
--	Significant Negative	• Option would lead to major increases in water use compared to prior to development such that the risk of water shortages in an area is significantly increased and abstraction is significantly beyond sustainable levels; • Option would lead to an exceedance of an abstraction license limit; • Option would lead to major increases in the amount of waste water, surface run-off and/or pollutant discharges so that the quality of water receptors (including groundwater, surface water, sea water or drinking receptors) would be considerably increased and some or all water targets (including those relevant to chemical and ecological condition) would not be achieved.
?	Uncertain	• From the level of information available the effect that the option would have on this objective is uncertain.

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 5.6 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria[221]' and 'No NPS' on the water quality (including surface and ground water quality and availability) objective (hereafter referred to as water quality and resources). The appraisal considers in-turn the three sub-sections used for each topic within Chapter 5 (Impacts) of the draft NPS: Applicant's Assessment; Decision Making and Mitigation. The performance of the draft NPS and the two reasonable alternatives are scored accordingly, with a commentary provided in the Appraisal column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15 - 20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement. These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-term (less than 20 years), MT – medium-term (between 20 and 170 years) and LT – long-term (>170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

[221] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

Table 5.6 Appraisal of the Draft NPS and Reasonable Alternatives: Water Quality (Including Surface and Ground Water Quality and Availability)

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	+	+	+/?	**Draft NPS:** The text in the draft NPS (5.14.4) under the heading of 'Applicant's Assessment' states that "*An applicant should make early contact with the relevant regulators, including the local authority and the Environment Agency (including for abstraction licensing), and with utility companies likely to be responsible for supplying the water. Early engagement can help establish if impact on the water environment is likely to be a significant planning concern and, if it is, to clarify what assessment will be needed to support the application. The information supplied should be proportionate to the nature and scale of development proposed and the level of concern about the water environment. Where the proposed development is likely to have adverse effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed development on, water resources and physical characteristics as part of the Environmental Impact Assessment and set this out in the Environmental Statement.*" Applicants are expected to state what measures they intend to put in place to provide suitable mitigation against the impact on local water resources and outline the emergency response procedures they will implement to deal with any pollution incident. At paragraph 5.14.5, the draft NPS identifies a number of potential design measures that applicants should demonstrate they have incorporated including: • independent water storage and collection facilities; • opportunities for reuse; • the use of automated leak detection (for non-disposal parts of the facility); and • building specific metering and rain harvesting. At paragraph 5.14.8, the draft NPS makes specific reference to existing guidance on groundwater. The requirement for early engagement with relevant regulators, for the preparation of an Environmental Statement (ES) and identification of mitigation measures (including emergency response procedures) will help to ensure that the likely effects of GDF-related NSIPs on water quality and resources are properly considered. *Recommendations for Improvement* It would be useful for the text to make direct reference to the Planning Practice Guidance on how water supply, wastewater and water quality should be considered as part of a development consent application (PPG Water supply, wastewater and water quality – considerations for planning applications, Paragraph: 016 Reference ID: 34-016-20140306 onwards). In addition, consideration could be given to the provision of additional guidance relating to the scope of any assessment on water quality and resources and which could include: • a description of the surface and ground water environment in the study area that could be affected by the proposed development; • the availability/capacity of water supply and wastewater treatment infrastructure (taking into account water company water resources management plans (WRMPs);

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• the identification of potential impacts on water resource availability; • the identification of the potential impacts on water quality including in respect of the achievement of River Basin Management Plan (RBMP) objectives; • the impacts on the marine environment (including bathing water quality) together with a requirement for early engagement with the Marine Management Organisation (MMO) (where appropriate) and consideration of marine plans; • the potential effects on aquatic ecology and habitats including a cross-reference to Section 5.4 of the draft NPS; • the effects of climate change on water resource availability and surface water flooding including cross reference to Sections 5.5 and 5.8 of the draft NPS.
				Draft NPS & Exclusionary Criteria: Positive effects on water quality and resources associated with this reasonable alternative are expected to be broadly similar to those identified in respect of the draft NPS above. It should be noted that the setting of clear parameters for siting which excludes specific environmental and cultural assets may indirectly help to avoid adverse impacts on water quality and resources in localities where they support water-dependent nature conservation sites (SACs, SPAs, Ramsar sites), although this is not considered to constitute a significant positive effect in the context of this objective.
				No NPS: Under this alternative, applications would be subject to the provisions of national planning policy and the EIA Regulations. Environmental permits for the discharge of contaminated water and abstraction licenses where water is supplied from surface water or groundwater bodies may also be required alongside a Marine License for works affecting marine areas. This is expected to help ensure that water quality and resources are not compromised by GDF-related development, generating a positive effect on this objective. However, the absence of a clear statement of the full range of considerations to be taken into account (as proposed in the draft NPS) risks inconsistency in interpretation, particularly at a project level.
Decision Making	**+**	**+**	**+/?**	**Draft NPS:** The draft NPS stipulates that the Secretary of State will generally need to give impacts on the water environment more weight where a development would have adverse effects on the achievement of the environmental objectives established under the Water Framework Directive (2000/60/EC). At paragraph 5.14.11 it states that "*The Secretary of State should be satisfied that a proposal has had regard to the River Basin Management Plans and the requirements of the Water Framework Directive (including Article 4.7) and its daughter directives, including those on priority substances and groundwater. The specific objectives for particular river basins are set out in River Basin Management Plans*." At paragraph 5.14.12, the draft NPS emphasises the need for the Secretary of State to consider mitigation measures proposed by the applicant and whether appropriate requirements should be attached to any development consent and/or whether planning obligations are necessary. In light of the strong emphasis on the need for the Secretary of State to give due consideration to impacts on the water environment in the context of the Water Framework Directive and RBMPs, and taking into account the provisions relating to

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				mitigation/planning obligations, the draft NPS has been assessed as having a positive effect on this objective. *Recommendations for Improvement* It is considered that this section of the draft NPS could make more explicit the key considerations to be taken into account by the Secretary of State in determining DCO applications including impacts on water resource availability (with reference to water company WRMPs), surface and ground water quality and bathing water (with reference to marine plans), where relevant. It is also considered that the guidance could be more definitive in respect of the circumstances in which the Secretary of State would refuse consent due to unacceptable impacts on the water environment.
				Draft NPS including Exclusionary Criteria: Positive effects on water quality and resources associated with this reasonable alternative are expected to be broadly similar to those identified in respect of the draft NPS above. It should be noted that the setting of clear parameters for siting which excludes specific environmental and cultural assets will aid decision making and may indirectly help to avoid adverse impacts on water quality and resources in localities where they support water-dependent nature conservation sites (SACs, SPAs, Ramsar sites), although this is not considered to constitute a significant positive effect in the context of this objective.
				No NPS: Under this alternative, applications would be subject to the provisions of national planning policy and the EIA Regulations. Environmental permits for the discharge of contaminated water and abstraction licenses where water is supplied from surface water or groundwater bodies may also be required alongside a Marine License for works affecting marine areas. This is expected to help ensure that water quality and resources are not compromised by GDF-related development, generating a positive effect on this objective. However, the absence of a clear statement regarding the full range of considerations to be taken into account by the Secretary of State (as proposed in the draft NPS) risks inconsistency in interpretation, particularly at a project level.
Mitigation	**+/?**	**+/?**	**+/?**	**Draft NPS:** The draft NPS sets out that impacts on local water resources can be minimised through planning and design for the efficient use of water whilst adverse effects on water quality can be reduced through careful design to facilitate adherence to good pollution control practice. Whilst this guidance is expected to help ensure that adverse effects arising from GDF-related development are minimised (generating a positive effect on this objective), it is considered that (as currently worded) the draft NPS lacks specificity in terms of the suite of measures that could be implemented to address effects at key project stages. However, it is noted that the Radioactive Waste Management Ltd (2016) Geological Disposal Generic Environmental Assessment Report highlights that any GDF would be designed in accordance with 'best available techniques' (BAT), the requirements of the 'groundwater daughter directive' and other regulatory requirements to protect the environment (and in particular the water environment), as without this it could not obtain an Environmental Permit or begin operation. This means that, as a matter of course: • a GDF would incorporate facilities to treat its own foul water, water drained from the surface site and water pumped from underground before discharge; • that there would be facilities to attenuate any surface water run-off, preventing any increase in flood risk; • that drilling, mining and underground construction techniques and materials would be designed to prevent the

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				release of contaminants into the groundwater; and • the refuelling areas would be bunded and sealed to prevent release of hydrocarbons or other chemicals into the environment. Further, site selection work will ensure that there is a good understanding of hydrological conditions, including groundwater movement and flood risk, prior to construction commencing. *Recommendations for Improvement* The mitigation could be revised to be more specific and clearly reflect the key project stages of site investigation, construction, operation and closure, as follows[222]: *Site Investigation* Water will be required throughout the borehole drilling programme for use in construction activities, laboratories and for drinking water, sanitation etc. At paragraph 5.14.5, the draft NPS identifies a number of measures that could reduce water use including exploring opportunities for reuse, metering and rain harvesting. These measures could be usefully included at paragraph 5.14.14 alongside reference to the implementation of water efficiency measures and the need to identify/minimise potential abstraction needs and sources (in consultation with regulatory authorities). During borehole construction and operation, there is the potential for spillage, discharges and surface water run-off (due to increases in impermeable surface areas) that could affect surface water quality or the rate of flows in receiving waters. There may also be the risk of the release of contaminants to groundwater. Mitigation measures in this context could include: • Locate potential drilling sites/compounds/access roads etc. to avoid/minimise adverse effects on the water environment. • Ensure watercourse crossing numbers are minimised and flood and pollution control measures incorporated where crossings are required. • Design surface drainage for all relevant surface works incorporating SUDS where possible, with attenuation to greenfield rates of run-off and no increase in run-off volumes where possible. • Incorporate protection / treatment of run-off to avoid siltation of watercourses where necessary. • Establish appropriate pollution control measures in line with an environmental management plan. • Drilling specification, including casings and fluid, designed to prevent entry of fluid to groundwater and incorporate regular monitoring.

[222] Derived from: by Radioactive Waste Management Limited (December 2016) *Geological Disposal Generic Environmental Assessment*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• Ensure water discharge storage capacity available on site. • Decommission boreholes in line with best practice guidelines and environmental management plan. The Radioactive Waste Management Ltd (2016) Geological Disposal Generic Environmental Assessment Report highlights that opportunities may exist at borehole drilling locations to enhance water quality and/or reduce the risk of flooding. The Report also notes that knowledge of the groundwater at each borehole drilling location will improve through the results of the siting process, creating opportunities for learning. *Construction* During construction, it is anticipated that water requirements would be more substantial, although the range of mitigation measures would be as for site investigation. The range and type of effects on water quality identified under site investigation would also be similar, although the probability of such effects occurring and their magnitude could be increased commensurate with the increased scale of activity at this stage. Additional potential sources of effects on water quality during this stage would include dewatering, which could affect surface water bodies through reduction in the water table and through discharge of water with a high sediment load, and the storing of excavated rock in surface bunds (although this would vary by rock type). There may also be the potential for adverse effects on marine waters associated with (in particular) the construction of any new, or expansion of existing, port infrastructure. Additional mitigation measures (beyond those identified under site investigation) during this stage could include: • New construction-phase environmental management plan(s). • Flood Risk Assessment. • Construction site and permanent drainage to incorporate SUDS, with surface storage and attenuation to greenfield rates and with no increase in run-off volume where possible. • Establish pollution control measures. • Grouting and lining of tunnel / shafts to minimise water ingress. • Plan works to minimise duration of dewatering requirements. • Establish any treatment facilities early. • Stockpile management procedures used to prevent risk of leachate, siltation especially lower strength sedimentary rock. • Cover excavated rock, especially lower strength sedimentary or evaporite rock, rapidly with soil, to prevent risk of leachate, siltation etc. • Design development – once specific geological conditions are known, consider appropriateness of rock type for use in bunds and/or specific design requirements for bunds. *Operation*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Water requirements during this stage would be related to the continuation of underground excavation of vaults/tunnels whilst potential effects on water quality would be similar to those identified above for construction. In consequence, mitigation measures would be the same as those already identified but could additionally include: • New, operational phase environmental management plan(s). • Continuous management / maintenance of water environment mitigation and water management features on site. *Closure* Water requirements during closure would be related to activities associated with backfilling and routine processes (but would reduce as closure progressed). Effects on water quality, meanwhile, would initially be of a similar, or lesser, scale and nature to those described for the operational phase but would reduce as closure is progressed. in consequence, the mitigation measures identified above would apply in addition to the following: • All boreholes no longer required for ongoing monitoring to be decommissioned in accordance with best practice guidance current at the time. • Site restoration should ensure a similar surface run-off regime to that originally present, allowing for any other changes in the surrounding environment in the intervening decades (unless an alternative end state is agreed with the local community).
				Draft NPS including Exclusionary Criteria: The specification of exclusionary criteria is unlikely to make a difference to the application of the mitigation and enhancement measures as set out for the draft NPS above, and as such the predicted effects are likely to be similar.
				No NPS: Appropriate mitigation measures will be considered by the competent authority in light of the proposals submitted. As such, mitigation measures will be applied but there is the risk that this is open to interpretation and thereby does not fully address an appropriate range of activities which are directly related to the scheme.
Other Sections of the Draft NPS Relevant to Water Quality	**1. Introduction** 1.1.3 There is an opportunity for the consideration of effects on water quality and resources in a specific locality through the preparation of a local impact report submitted by a local authority in accordance with the Planning Act. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on water quality and resources as an issue, helping to ensure that consideration is given to likely effects in a particular locality. 1.1.5 Consideration of the effects on the water environment is reflected in the need to apply the draft NPS in the context balancing adverse impacts and benefits. The net result of this balancing exercise could be uncertain, however. 1.1.7 The generic impacts considered in the draft NPS, along with the application of the draft NPS as a material consideration on a case by case basis, could result in uncertainty over what provisions will be applied in respect of the consideration of water quality and resources and the mitigation of adverse effects.			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	Sections 1.1.14 and 1.1.15 outline the process by which the relevant independent statutory regulators assess the nuclear safety, security and environmental protection of the facility which is also distinct from the application for development consent. **1.4 Consideration of deep boreholes investigations** – the role and content of an ES, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of potential water quality/resources impacts, avoiding or reducing harm and providing appropriate mitigation measures where required. **1.5 Consideration of geological disposal facilities** – the spatial disposition of facilities and the timescale of development could affect water quality and resources although the requirements for limiting cumulative negative impacts within safety and reasonable financial constraints should help to minimise impacts. The Environment Agency will regulate the environmental aspects of the GDF including, inter alia, any discharges to water and abstractions. Regulatory approval from the Environment Agency is not a prerequisite to the granting of development consent and therefore not required at the application stage, however the Secretary of State and Examining Authority may wish to seek advice on the progress of appropriate environmental authorisations. **2. Government Policy on Management of Higher Activity Radioactive Waste** 2.2.6. The preference for disposal through a single site will help to confine effects to a specific area thus limiting effects on water quality and resources, although these would be greater in a single location and could still be significant in respect of a particular site. 2.4.3 The strategy for implementation provides for the opportunity to consider water quality and resources as the process proceeds iteratively, including discussions with communities of interest. **3. The Need for Geological Disposal Infrastructure** No direct relationship identified. **4. Assessment Principles** **4.1 General principles of assessment** - the provisions of the Planning Act and the policies and protections set out in the draft NPS provide for a balanced consideration of impacts and benefits. The requirement for the identification of positive and adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for consideration of water quality and resources issues. **4.2 Environmental Impact Assessment**– the consideration of proposals within the EIA Regulations and the preparation of an ES (where required) agreed by statutory agencies and specifying mitigation and enhancement measures will ensure that impacts on water quality and resources are fully considered, as will the consideration of cumulative effects and interrelationships between effects. **4.3 Habitats Regulations Assessment** – requirements in relation to the Habitats Directive may help to protect water bodies where they are related to water-dependent Natura 2000 sites. **4.4 Alternatives** – the identification that reasonable alternatives will be required as part of scheme design and project planning should ensure that impacts on water quality and resources are taken into account, both in terms of protection and opportunities for mitigation and enhancement. **4.5 Criteria for 'good design for geological disposal infrastructure** – the requirement for applicants to include design as an integral consideration from the outset of a proposal is expected to help ensure that measures are adopted to minimise the use of resources including water. Good design, in terms of siting and use of appropriate technologies and landscaping can also help to mitigate adverse impacts on water quality (for example, by reducing surface water run-off). **4.6 Climate Change Adaptation** – ensuring that development is adaptable to the effects of climate change will in-turn help to ensure that proposals take into account the impacts of climate change when considering water availability and water quality. Climate change adaptation measures could also help to reduce flood risk with consequential benefits in respect of water quality. **4.7 Pollution Control and other Environmental Regulatory Regimes** – issues relating to discharges from a proposed project which affect, inter alia, water quality and			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	resources will be subject to separate regulation under the pollution control framework or other consenting or licensing regimes. At para 4.7.9, the draft NPS sets out that the "*Secretary of State should be satisfied that development consent can be granted taking full account of environmental impacts. This will require close cooperation with the Environment Agency and/or the pollution control authority, and other relevant bodies, such as the Marine Management Organisation, Natural England, Drainage Board, local authorities and water and sewerage undertakers as appropriate, to ensure that in the case of a potentially polluting development:* • *the relevant pollution control authority is satisfied that potential releases can be adequately regulated under the pollution control framework; and* • *the effects of existing sources of pollution in and around the proposed development are not such that the cumulative effects of pollution when the proposed development is added would make that development unacceptable, particularly in relation to statutory environmental quality limits."* This is expected to help ensure that potential impacts on water quality and resources (including in marine areas) are fully taken into account. **4.8 Common Law Nuisance and Statutory Nuisance** – no direct relationship identified. **4.9 Safety** – no direct relationship identified. **4.10 Health** – no direct relationship identified. **4.11 Security Considerations** – no direct relationship identified. **Section 5 (other topics)** – it should be noted that there are links between water quality and resources and other topics contained in Section 5 of the draft NPS including, in particular, those related to biodiversity and nature conservation, climatic factors and flood risk and coastal change. Taken together, it is anticipated that these topics will generate further positive effects in respect of the protection and enhancement of water quality and resources.			
Summary Appraisal of Likely Significant Effects	+	+	+?	**Draft NPS:** The development of GDF-related infrastructure is likely to require substantial volumes of water, particularly during the construction phase. The siting, construction, operation and closure of a GDF and associated development may also have adverse effects on water quality due to, for example, the migration of contaminants. In this context, the draft NPS requires (in liaison with key regulators and other bodies with an interest in the water environment) that potential impacts on water quality and resources are identified, assessed and, where necessary, mitigated. This is expected to help minimise water requirements and waste water production and protect surface, groundwater, estuarine and coastal water quality. Overall, the draft NPS is considered to provide a clear framework to guide decisions on GDF-related NSIPs in respect of the water environment. It complements existing national planning policy and legislation as well as the objectives of RBMPs in respect of the Water Framework Directive. In consequence, the draft NPS has been assessed as having a positive effect on this objective.
				Draft NPS including Exclusionary Criteria: Positive effects on water quality and resources associated with this reasonable alternative are expected to be broadly similar to those identified in respect of the draft NPS above. It should be noted that the setting of clear parameters for siting which excludes specific environmental and cultural assets may indirectly help to avoid adverse impacts on water quality and resources in localities where they support water-dependent nature conservation sites (SACs, SPAs, Ramsar sites), although this is not considered to constitute a significant positive effect in the context of this objective.
				No NPS: Under this alternative, applications would be subject to the provisions of national planning policy and the EIA

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Regulations. Environmental permits for the discharge of contaminated water and abstraction licenses where water is supplied from surface water or groundwater bodies may also be required alongside a Marine License for works affecting marine areas. This is expected to help ensure that water quality and resources are not compromised by GDF-related development, generating a positive effect on this objective. However, the absence of a clear statement regarding the full range of considerations to be taken into account by the applicant and Secretary of State (as proposed in the draft NPS) risks inconsistency in interpretation, particularly at a project level.
Summary of Recommending Mitigation and Enhancement	The draft NPS sets out that impacts on local water resources can be minimised through planning and design for the efficient use of water whilst adverse effects on water quality can be reduced through careful design to facilitate adherence to good pollution control practice. However, it is considered that this mitigation could be revised to be more specific and clearly reflect the key project stages of site investigation, construction, operation and closure. Additionally, the draft NPS could make more explicit the key considerations to be taken into account by the Secretary of State in determining DCO applications and be more definitive in respect of where and in what circumstance(s) the Secretary of State would refuse consent due to unacceptable impacts on the water environment. Finally, the draft NPS could provide further guidance with respect to the assessment of water quality and resources as part of any ES (as required).			

6. Flood Risk and Coastal Change

Introduction

This section presents the overview of plans and programmes, baseline information and the appraisal of sustainability of the National Policy Statement for Geological Disposal Infrastructure and reasonable alternatives in respect of flood risk and coastal change.

Flood risk within this context is defined as the risk of coastal, river, surface water, sewer and groundwater flooding. Coastal change in this context has been defined narrowly to include coastal processes coastal erosion.

There are links between flood risk and coastal change and a number of other Appraisal of Sustainability (AoS) topics, in particular water quality and climatic factors.

Review of Plans and Programmes

A significant proportion of the UK population is at risk of flooding, with the level of risk ranging from minor through to potentially life threatening. As such, there is a well established policy framework to identify, quantify, assess, avoid, minimise and mitigate flood risk in the UK. Key to the protection of people, homes and communities is the consideration of the long-term effects of climate change in terms of how issues such as increased rainfall and sea level rise will be managed. A geological disposal facility will also need to be designed to take into account flood risk, both in terms of the direct threat from flooding as well as ensuring that the design is appropriate given the anticipated increase in flood risk.

International/European

The ***Floods Directive (2007/60/EC)*** aims to provide a consistent approach to managing flood risk across Europe. The approach is based on a 6 year cycle of planning which includes the publication of Preliminary Flood Risk Assessments, hazard and risk maps and flood risk management plans. The Directive is transposed into English law by the ***Flood Risk Regulations 2009*** (SI 2009/3042).

The Floods Directive is linked to the ***Water Framework Directive (WFD) (2000/60/EC)*** and requires flood risk appraisals to be produced at a River Basin District scale and working with the timing of the WFD River Basin Planning cycles.

The ***Marine Strategy Framework Directive (2008/56/EC)*** requires Member States to take the necessary measures to achieve or maintain good environmental status in the marine environment by 2020 at the latest through the development and implementation of marine strategies.

UK

The ***Flood and Water Management Act 2010*** contains provisions for regional working and co-operation such as the establishment of regional flood and coastal committees and the bringing together of lead local flood authorities, who will have a duty to cooperate, to develop local strategies for managing local flood risk. In addition, the ***Flood Risk Regulations 2009*** (SI 2009/3042) impose a duty on the Environment Agency and lead local flood authorities to take steps to identify and prepare for significant flood risk. The ***Climate Change Act 2008*** also

imposes a duty on the UK Government to compile every five years an assessment of the risks and opportunities arising for the UK from climate change, including in relation to flood and coastal erosion risks. The UK Committee on Climate Change Adaptation Sub-committee ('the UK CCC ASC') is responsible for preparing these climate change risk assessments, the latest of which, the second UK Climate Change Risk Assessment (CCRA2) Evidence Report, was published in July 2016[223].

As set out in **Section 5**, ***Shoreline Management Plans (SMPs)*** assess the risks to people, development and the natural and historic environment from coastal processes.

The ***Marine and Coastal Access Act 2009*** provides the legal mechanism to help ensure clean, healthy, safe, productive and biologically diverse oceans and seas by putting in place a new system for improved management and protection of the marine and coastal environment. The Act comprises several key elements or parts. In relation to coastal processes (in the context of this report), three elements are particularly pertinent. First, the Act allows for the creation of a Marine Management Organisation (MMO) to deliver marine functions in the waters around England and in the UK offshore area (for matters that are not devolved), including the preparation of marine plans. Second, the Act creates a new UK-wide strategic marine planning system to enable more strategic and effective management of seas. Third, the Act makes changes to the marine licensing system that will result in more consistent licensing decisions for marine works and activities.

The Marine Strategy Framework Directive has been transposed into UK law through the ***Marine Strategy Regulations 2010*** (SI 2010/1627). It aims to achieve good environmental status of the EU's marine waters by 2021 and to protect the resource base upon which marine-related economic and social activities depend.

The main objectives of the ***Marine Policy Statement (2011)*** prepared under the Marine and Coastal Access Act 2009 are to enable an appropriate and consistent approach to marine planning across UK waters, and to ensure the sustainable use of marine resources and strategic management of marine activities from renewable energy to nature conservation, fishing, recreation and tourism.

England

The Floods Directive is transposed into English law through the ***Flood Risk Regulations 2009*** (SI 2009/3042) which complement the Flood and Water Management Act 2010. Following this legislation, the 2011 Environment Agency ***National Flood and Coastal Erosion Risk Management Strategy for England***[224] seeks to ensure that flooding and coastal erosion risks are well-managed and co-ordinated, so that their impacts are minimised through better understanding of the risks, management of the likelihood, helping people to manage their own risk, preventing inappropriate development and improving flood prediction and post-flood recovery. Section 171 of the ***Housing and Planning Act 2016*** requires the Secretary of State to carry out a review of planning legislation, government planning policy and local planning policies concerning sustainable drainage in relation to the development of land in England, and this is presently ongoing.

The MMO has identified 11 marine planning areas (MPAs) around England and is currently preparing marine plans for these areas, all of which are scheduled to be in place by 2021 and

[223] UK CCC ASC (2016) *UK Climate Change Risk Assessment 2017: CCRA2 Evidence Report*. Available online at: https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/
[224] Environment Agency (2011) *National flood and coastal erosion risk management strategy for England*. Available online at: https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england

thereafter reviewed every 3 years. The East Inshore and East Offshore marine plan areas were the first two areas where work commenced on their marine plans, with other areas now following.

To complement the National Flood and Coastal Erosion Risk Management Strategy for England, risks associated with coastal change are being addressed through ***Shoreline Management Plans*** which are being developed across England (and Wales), whilst information on the national risk from coast erosion has been collated. ***Surface Water Management Plans*** are being developed and revised across England (and Wales), with accompanying technical guidance[225].

The ***National Planning Policy Framework (Department for Communities and Local Government. 2012)*** (at paragraph 100) seeks to avoid inappropriate development in areas at risk of flooding by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. Technical guidance published alongside the NPPF sets out how this policy should be implemented, including the Flood Risk and Coastal Change section of the ***Planning Practice Guidance*** and Defra's ***Non-statutory technical standards for sustainable drainage systems***[226]. Local Plans should be supported by Strategic Flood Risk Assessments and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as lead local flood authorities and internal drainage boards. Local Plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change. This includes applying a sequential test to steer new development to areas with the lowest probability of flooding. Local planning authorities are also expected to set out the strategic priorities for their area in the Local Plan including strategic policies to deliver the provision of infrastructure for flood risk and coastal change management.

When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider appropriate development in areas at risk of flooding, informed by a site-specific flood risk assessment (NPPF paragraph 103). A site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

Flood defence consents under the ***Land Drainage Act 1991*** and the ***Water Resources Act 1991*** (and associated byelaws) will be required if any of the following apply:

- works in, over, under, or within the byelaw margin of main rivers, or likely to affect the integrity of tidal defences;
- raising ground levels in the floodplain beside a main river; and
- constructing or altering a culvert or structure to control the flow of the river (such as a weir) on any ordinary watercourse.

[225] Defra (2010) *Surface Water Management Plan Technical Guidance*. Available online at: https://www.gov.uk/government/publications/surface-water-management-plan-technical-guidance
[226] Defra (2015) *Non-statutory technical standards for sustainable drainage systems.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

Scotland

The ***Flood Risk Management (Scotland) Act 2009*** includes a duty placed upon Scottish Ministers, the SEPA, local authorities, Scottish Water and other responsible authorities to exercise their functions with a view to managing and reducing flood risk and to promote sustainable flood risk management. As a means of identifying the highest risk areas, ***Surface Water Management Plans*** are being developed across the country, based on accompanying technical guidance[227].

The ***Climate Change (Scotland) Act 2009*** requires the Scottish Ministers to lay a Climate Change Adaptation Programme before the Scottish Parliament after the UK Secretary of State publishes a climate change risk assessment report, as required by the Climate Change Act 2008. The first ***Climate Ready Scotland: Scottish Climate Change Adaptation Programme***, which included consideration of climate related flood risks, was published in March 2014 and another will follow once the second UK Climate Change Risk Assessment (CCRA2) is finalised in 2017

Flood Risk Management Strategies for Scotland are currently being prepared for 14 local plan districts. Once adopted, the Strategies will set out the most sustainable combination of actions to address flooding in the areas at greatest risk, where the benefits of intervention can have the greatest impact. Taken together, the 14 Flood Risk Management Strategies will provide a national plan for Scotland.

Scotland's ***National Marine Plan (2015)***[228] has been adopted by the Scottish Government and is a single framework to enable the sustainable development of Scotland's marine area in a way which will protect and enhance the marine environment, whilst ensuring the sustainable growth of both existing and emerging marine industries.

The key aims of the ***Scottish Planning Policy (SPP) (2014)*** in relation to flooding are:

- to prevent developments which would be at significant risk of being affected by flooding;
- to prevent developments which would increase the probability of flooding elsewhere; and
- to provide a basis for planning decision making related to flood risk (the SPP provides a risk framework which divides flood risk into three categories and outlines an appropriate planning response).

With regard to flood risk, the SPP (2014) states that developers and planning authorities should take a precautionary approach in making decisions when flood risk is an issue and that development should not take place on land that could otherwise contribute to managing flood risk, for instance through managed coastal realignment, washland creation or as part of a scheme to manage flood risk. With respect to coastal issues, SPP states that planning authorities should take the likely effect of proposed development on the marine environment into account when making decisions on planning applications. The SPP also notes that the risks associated with rising sea levels and coastal flooding should be taken into account when identifying areas that are suitable for development.

[227] Scottish Government (2013) *Surface Water Management Planning Guidance*. Available online at: http://www.scotland.gov.uk/Publications/2013/02/7909 and The Scottish Government (2015) *Online Planning Advice on Flood Risk.* Available online at: http://www.gov.scot/Topics/Built-Environment/planning/Policy/Subject-Policies/natural-resilient-place/Flood-Drainage/Floodrisk-advice

[228] Scottish Government (2015) *Scotland's National Marine Plan*. Available online at: http://www.gov.scot/Resource/0047/00475466.pdf

Wales

Chapter 13: Minimising and managing environmental risks and pollution of ***Planning Policy Wales (Edition 9) (2016)*** sets out the policies of the Welsh Government regarding flood risk and climate change. Flood risk, whether inland or from the sea, is a material consideration in land use planning. The Welsh Government's objective in relation to flood risk management is to move towards positive avoidance of development in areas defined as being of flood hazard.

In support of Planning Policy Wales, ***TAN 14: Coastal planning (1998)*** and ***TAN 15***: ***Development and flood risk (2004)*** provide detailed planning advice on their respective subjects. TAN 14 provides advice on planning the coastal zone, recreation, heritage coasts and non-statutory coastal groupings and shoreline management plans. TAN 15 provides advice on development advice maps, nature of development or land use, justifying the location of built development, assessing flooding consequences, surface water run-off from new development, action through development plans and development control.

The ***Environment (Wales) Act 2016*** establishes a Flood and Coastal Erosion Committee and contains a range of other relevant provisions. This new committee replaces Flood Risk Management Wales (FRMW), which was established under section 22 of the Flood and Water Management Act 2010 to scrutinise the work and budget of Environment Agency Wales, now Natural Resources Wales (NRW). The establishment of this committee seeks to resolve dual accountability issues and to adopt a wider, advisory/consultative role than solely the scrutiny role previously undertaken by FRMW. In doing so the new committee is responsible for providing advice to the Welsh Ministers on a wider range of flood and coastal erosion issues from various bodies, not just to NRW.

Overview of the Baseline

UK

Flooding is associated with a range of sources: river, coastal, surface water, sewer, groundwater and reservoir[229].

Coastal erosion is occurring along 17% of the UK coastline[230]. Sea levels are rising, and are greater in the south of the UK than the north. The global-average sea level rose during the 20th century at an average rate of 1-2 mm/year, with some consensus on the larger value by the research community. The rate was larger (approximately 3mm/year) during the 1990s. UK sea level records are consistent with these values but with smaller trends observed in Scotland (where the land is uplifting) than in the south of the UK[231].

England

Approximately 2.4 million properties in England are currently at risk from flooding from rivers and the sea, of which approximately 155,000 residential properties are within high flood risk areas, and around 3 million properties are at risk from surface water flooding, including approximately 215,000 residential properties within high flood risk areas. The total area of agricultural land at risk of flooding is around 12% (1.3 million ha) whilst 122,000 and 290,000

[229] Environment Agency. Sources of flooding. Available online at: http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/homeandleisure/floods/31652.aspx
[230] Marine Climate Change Impacts Partnerships. *Impacts of climate change on coastal erosion*. Available online at: http://www.mccip.org.uk/impacts-report-cards/full-report-cards/2013/climate-of-the-marine-environment/
[231] Marine Climate Change Impacts Partnerships, sea level. Available online at: http://www.mccip.org.uk/media/1301/mccip-arc2013.pdf

properties are located within areas at risk of groundwater flooding (not including properties also in areas at risk of flooding from rivers and the sea)[232].

Regionally, Greater London has the highest number of people at risk from flooding, with around 542,000 properties and one million people located in the floodplain. However, although London does have the largest number of people at risk, 84% are in areas with a low chance of flooding. This is mainly due to the major flood defences and flood defence structures in the Thames Estuary, including the Thames Barrier. The City of Kingston-upon-Hull and East Riding in Yorkshire are the two local authorities with the highest number of properties with a chance of flooding. However, other local authorities, such as Boston and North Somerset, have a higher share of properties in areas of significant flood risk. For instance, Boston has about two-thirds of its properties in areas with a significant chance of flooding[233].

Coastal erosion is occurring along 30% of England's coastline[234] and current estimates suggest that around 740 properties in England are vulnerable to coastal erosion by around 2030, with a further 1,500 vulnerable by around 2060[235]. Of the regions in England, Yorkshire and Humber has the greatest proportion of coastal length which is eroding at 56% (203km). Coastal erosion is occurring along 30% to 32% of the south east, south west and east England's coastlines whilst 27% and 18% of the north east and north west coastlines respectively are eroding. The east midlands has the smallest proportion of coastal length which is eroding at 9% or 21km[236].

Scotland

In Scotland, SEPA has mapped a strategic national overview of flood risk in Scotland from rivers and the sea[237]. Around 1 in 22 of all residential properties and 1 in 13 non-residential properties is at medium risk of flooding from all sources (i.e. areas where the risk of flooding is greater than a 1 in 200 annual probability)[238]. The fourteen approved Flood Risk Management Strategies identify 'Potentially Vulnerable Areas' across Scotland and characterise flood risk within these[239]. Coastal erosion is occurring along 12% of Scotland's coastline[240].

Wales

As at March 2014 there were 208,000 properties shown to be at risk from river and / or sea flooding in Wales, 61,000 being at high or medium risk (greater than a 1% chance every year).

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[232] Environment Agency (2016) *Adapting to a changing climate: The Environment Agency's second adaptation report under the Climate Change Act*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/526000/climate-adrep-environment-agency.pdf and Environment Agency (2015) *Managing flood and coastal erosion risks in England: 1 April 2014 to 31 March 2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/447646/LIT_10125_FCERM_Annual_Report_2014_to_2015.pdf

[233] Environment Agency (2009) *Flooding in England: A National Assessment of Flood Risk*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/292928/geho0609bqds-e-e.pdf

[234] Marine Climate Change Impacts Partnerships (2009) *Coastal erosion and coastal geomorphology*. Available online at: http://www.mccip.org.uk/impacts-report-cards/full-report-cards/2007-2008/marine-environment/coastal-erosion/

[235] Environment Agency (2016) *Adapting to a changing climate: The Environment Agency's second adaptation report under the Climate Change Act.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/526000/climate-adrep-environment-agency.pdf

[236] Marine Climate Change Impacts Partnerships (2013). *Impacts of climate change on coastal erosion*. Available online at: http://www.mccip.org.uk/impacts-report-cards/full-report-cards/2013/climate-of-the-marine-environment/

[237] Scottish Environment Protection Agency (2015) *Flood Maps*. Available online at: http://map.sepa.org.uk/floodmap/map.htm

[238] SEPA (2015) *Strategic Environmental Assessment: Flood Risk Management Strategies Environmental Report – consultation*. Available online at: http://www.sepa.org.uk/media/163415/sea_environmental_report.pdf

[239] SEPA (2015) *Flood Risk Management Strategies*. Available online at: http://apps.sepa.org.uk/FRMStrategies/

[240] Marine Climate Change Impacts Partnerships (2009) *Coastal erosion and coastal geomorphology*. Available online at: http://www.mccip.org.uk/impacts-report-cards/full-report-cards/2007-2008/marine-environment/coastal-erosion/

163,000 properties were at risk of surface water flooding, with 43,000 being at high or medium risk[241].

Across the local authorities in Wales, Cardiff has the highest numbers of properties at risk from flooding from rivers or the sea. However, many of these are at low risk (less than one in 200 chance in any given year), mainly because of the flood defence structures in place in Cardiff. Conwy has the largest number of properties at significant risk (greater than a 1 in 75 chance in any given year). This is largely because of the coastal flood risk. Coastal flooding is also the cause of the significant risk to property in Gwynedd and Newport[242]. Coastal erosion is occurring along 23% of Wales' coastline[243].

Summary of Existing Problems Relevant to the Geological Disposal NPS

The following existing problems for flood risk and coastal change have been identified:

- Some 15% of UK properties are at risk from flooding (surface water, river or coastal), although the degree of risk varies.
- The UK Climate Change Risk Assessment 2017: Projections of future flood risk projected that the number of residential properties exposed to flooding more frequently than 1:75 years (on average) increases from 860,000 today to between 1.2 million and 1.7 million properties in 2080, depending on the scenario considered.
- Sea levels are rising, with worst case scenarios of a 1.9m increase in sea level by 2100 (with up to 0.76m more likely). The south and east of England will experience the greatest effective increases, due to the effects of post-glacial rebalancing.
- Many coastal sites (especially in the south and east of the country) are already prone to erosion, due to their underlying geology, coupled with rising sea levels and increased storm intensity. Increasing development pressures on and around the coastal environment (often accompanied by coastal engineering projects such as sea defences) are, on occasion, conflicting with the need for their effective management in the face of climate change. Shoreline Management Plans (in England and Wales) are taking a long-term view of coastal change by identifying sustainable management approaches for up to the next 100 years.
- Flood risk presents a significant planning issue in the development of major infrastructure projects, both in terms of potential direct impacts on the project itself and indirect impacts associated with works (such as increased run-off).

[241] Natural Resources Wales (2015) *Flood and Coastal Erosion Risk Management in Wales, 2011-2014*. Available online at: http://gov.wales/topics/environmentcountryside/epq/flooding/nationalstrategy/strategy/flood-coastal-erosion-risk-management-wales-11-14/?lang=en

[242] Environment Agency Wales (2009) *Flooding in Wales: A National Assessment of Flood Risk*. Available online at: http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/static/documents/Research/ENV0005_Flooding_in_Wales_ENGLISH_AW_LR(1).pdf

[243] Marine Climate Change Impacts Partnerships (2009) *Coastal erosion and coastal geomorphology*. Available online at: http://www.mccip.org.uk/impacts-report-cards/full-report-cards/2007-2008/marine-environment/coastal-erosion/

Likely Evolution of the Baseline

UK

Climate change is likely to exacerbate erosion and flooding as a result of sea level rise together with a potential increase in the intensity, severity and frequency of storm events over the next 100 years. The most recent information for the UK from the UK Climate Impacts Programme (UKCIP) forecasts a range of relative sea level rise by the 2080s (relative to the 1961-1990 mean) of between 20 and 80cm in south-west England and 0 and 60cm in Scotland.

The scenarios in UKCIP 09 lead to several predictions relevant to flooding:

- Annual average precipitation across the UK may decrease by between 0% and 15% by the 2080s, depending on the scenario.
- The seasonal distribution of precipitation will change. Winters will become wetter and summers drier. The biggest relative changes will be in the south and east. Under the High emissions scenario, winter precipitation in the south-east may increase by up to 30% by the 2080s.
- By the 2080s, the daily precipitation intensities that are experienced once every two years on average may become up to 20% heavier. The scenarios give no guidance on the effects of climate change on more extreme precipitation events.
- By the 2080s, depending on scenario, relative sea level may be between 2cm below and 58cm above the current level in western Scotland and between 26 and 86cm above the current level in south-east England.
- For some coastal locations, a water level that at present has a 2% annual probability of occurrence may have a 33% annual probability by the 2080s for Medium High emissions[244].

UK Climate Change Risk Assessment 2017: Projections of future flood risk[245], which was commissioned by the UK CCC ASC to inform the CCRA2 projected that the number of residential properties exposed to flooding more frequently than 1:75 years (on average) increases significantly; increasing from 860,000 today to 1.2 million (a 40% increase) by the 2080s under a 2°C increase in Global Mean Temperature (GMT), and to 1.7 million (a 93% increase) under 4°C. The area of Special Protection Areas, Special Areas of Conservation and Ramsar sites exposed to flooding more frequently than 1:75 (on average) increases by 25% and 44% for 2°C and 4°C respectively by the 2080s. The area of Best and Most Versatile (BMV) agricultural land at risk from flooding increases by 32% and 65% under these climate projections. Impacts on social infrastructure are similar to those seen for residential property. By the 2080s, for scenarios based on GMT increases of 2°C and 4°C respectively, the number current community facilities increases substantially: the number of care homes located in the highest flood probability category increase by 48% and 140%; schools by 32% and 95%; emergency services sites by 36% and 100%; hospitals by 23% and 68%; and GPs surgeries by 46% and 140%, assuming current levels of adaptation are continued.

[244] UK Climate projections. Maps and key findings. Available online at: http://ukclimateprojections.defra.gov.uk/21708#key

[245] Sayers, P.B; Horritt, M; Penning-Rowsell, E; McKenzie, A (2015) *Climate Change Risk Assessment 2017: Projections of future flood risk in the UK. Research undertaken by Sayers and Partners on behalf of the Committee on Climate Change*. Available online at: https://www.theccc.org.uk/wp-content/uploads/2015/10/CCRA-Future-Flooding-Main-Report-Final-06Oct2015.pdf.pdf

England

The latest set of projected changes in climate for England comes from the 2009 UK Climate Projections. Under a medium emissions (A1B) scenario, regional summer mean temperatures are projected to increase by between 0.9 – 5.2ºC by the 2050s compared to a 1961-1990 baseline.

Assuming no population growth and a continuation of current levels of adaptation, it is considered that by the 2050s the projected number of people at 1:75 or greater risk of flooding rises to around 1.7 million (under a 2 degree scenario) and 2.2 million (for a 4 degree scenario). For the 2080s, the projections suggest 2 million people (under a 2 degree scenario) and 2.9 million people (under a 4 degree scenario) would be affected. Expected annual damage to residential properties is projected to rise by between 22 – 78% in the 2050s and 47 – 160% in the 2080s depending on climate scenario.

Around 480,000 ha of Best and Most Versatile (BMV) agricultural land is currently at a 1-in-75 or greater annual chance of flooding from rivers, surface water or the sea. This is projected to increase by 15% by the 2050s under a 2 degree centigrade rise in mean global temperatures and 41% under a 4 degree centigrade rise. Over 40,000 ha of agricultural land were inundated during the 2007 floods in England, causing damage estimated at £50 million. The floods and storm surge in 2013/14 caused an estimated £19 million of damage to agriculture.

Given the depth limited nature of the wave conditions along much of the coast of England, sea level is the most significant factor affecting loading on coastal defences, with the total amount of coastline at risk increasing from an estimated 114km in the 2020s to 171km in the 2080s. Sea level rise for London is expected to increase by between 35 – 49.7cm by 2090 depending on the emissions scenario, compared to a 1990 baseline.

Warmer, wetter winters and drier summers in the future could increase rates of soil weathering and increase soil erosion. This could in turn increase peak flows and hence fluvial and groundwater flood risk. This risk will be exacerbated where soils are degraded and compacted due to land management practices (medium magnitude/medium confidence)[246].

The Environment Agency estimates that over 700 properties could be lost to coastal erosion by around 2030, and over 2000 could be lost by around 2060. These estimates take into account the interventions proposed in shoreline management plans (SMPs). Without the interventions, these figures could increase to about 5,000 properties by 2030 and about 28,000 by 2060[247].

Scotland

As noted in **Section 6.2** above, ***Flood Risk Management Strategies for Scotland*** have been currently being prepared for 14 local plan districts, covering all of Scotland. These identify Potentially Vulnerable Areas where flood risks are greatest and set out the most sustainable combination of actions to address flooding in these areas. ***Local Flood Risk Management Plans*** have been developed in parallel and will provide additional local detail on the funding and delivery timetable for actions in six yearly periods, the first of which runs from 2016-2021[248].

[246] UK CCC ASC (2017) *UK Climate Change Risk Assessment 2017 Evidence Report – Summary for England*. Available online at: https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-England-National-Summary-1.pdf
[247] Environment Agency (2015) *Managing flood and coastal erosion risks in England: 1 April 2014 to 31 March 2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/447646/LIT_10125_FCERM_Annual_Report_2014_to_2015.pdf
[248] SEPA (2015) *Flood Risk Management Strategies*. Available online at: http://apps.sepa.org.uk/FRMStrategies/

The ***UK Climate Change Risk Assessment 2017 Evidence Report – Summary for Scotland***[249] notes that some coastal communities especially in the Hebrides, areas of the Solway Firth, Firth of Clyde and the coastline from Moray to Fife (including Aberdeen) may be at risk from increased storminess and wave overtopping, however there are uncertainties over the scale and timing of these risks.

On average, coastal floods have occurred once or twice a year based with a seasonal peak in winter (especially in January or February). The North Atlantic Oscillation (NAO) (the difference in sea level atmospheric pressure between the Azores and Iceland) is a major driver for storms and coastal floods in the North Atlantic. Positive values of the NAO index are associated with higher incidence of coastal floods in Scotland. As it is likely that NAO will become more positive by 2080, the frequency of coastal flooding may also increase.

Wales

Assuming no population growth and a continuation of current levels of adaptation, by the 2080s, the projections from the CCRA suggest 142,000 people under a 2 degree scenario and 209,000 people under a 4 degree scenario would be living in areas of Wales at a 1-in-75 or greater chance of flooding in any given year. Expected annual damage to residential properties in Wales is projected to rise by between 35 – 110% in the 2050s and 59 - 220% in the 2080s depending on climate scenario.

Some locations in Wales are known to be at risk from long-term changes to the coastline, such as the village of Fairbourne. Baseline rates of coastal erosion are between 30 and 100 metres per century. With sea-level rise, the rates could be 1.75 – 2.5 higher than the baseline due to strengthened wave action and other factors (equivalent to 52 – 250 metres per century). The Shoreline Management Plan for Fairbourne states that while the village's defences can and should be maintained for several decades (c. 40 years) in the long term the defences are unsustainable. The dominant factor in the case of Fairbourne is the rate of sea-level rise, about which there is much uncertainty[250].

Assessing Significance

The objectives and guide questions related to food risk and coastal change which have been identified for use in the appraisal of the effects of Geological Disposal Infrastructure NPS proposals are set out in **Table 6.1**, together with reasons for their selection.

Table 6.1 Approach to Assessing the Effects of the Geological Disposal infrastructure NPS Proposals on Flood Risk and Coastal Change

[249] UK CCC ASC (2017) *UK Climate Change Risk Assessment 2017 Evidence Report – Summary for Scotland.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf
[250] UK CCC ASC (2017) *UK Climate Change Risk Assessment 2017 Evidence Report – Summary for Wales*. Available online at: https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Wales-National-Summary.pdf

Objective/Guide Question	Reasoning
Objective: To minimise the risks from coastal change and flooding to people, property and communities, taking into account the effects of climate change.	The SEA Directive (2001/42/EC) requires that the likely significant effects on the environment, which includes population, human health, climatic factors, material assets and their integration, should be taken into account in the Environmental Report, which for the purposes of the AoS is incorporated within the AoS Report.
Will the Geological Disposal Infrastructure NPS help to avoid development in areas of flood risk and, where possible, reduce flood risk?	Minimising flood risk is a key part of sustainable development and is reflected in relevant legislation (such as Flood Risk Regulations 2009 and the Flood and Water Management Act 2010). Environmental and planning policy seeks to ensure that new development does not exacerbate risks (e.g. paragraph 100 of the National Planning Policy Framework 2012).
Will the Geological Disposal Infrastructure NPS help to avoid development in areas affected by coastal erosion and not affect coastal processes and/or erosion rates?	Changes to coastal processes or erosion rate caused by development have a potential to negatively impact on the marine environment. The Marine Strategy Framework Directive (2008/56/EC) require member states to achieve or maintain good environmental status in the marine environment by 2020.

Table 6.2 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the flood risk and coastal change objective.

Table 6.2 Illustrative Guidance for the Assessment of Significance for Flood Risk and Coastal Change

Effect	Description	Illustrative Guidance
++	Significant Positive	• Option would result in a significant decrease in people or property at risk of, or affected by, flooding, coastal inundation or sea level rise.
+	Positive	• Option would result in a decrease in people or property at risk of, or affected by, flooding, coastal inundation or sea level rise.
0	Neutral	• Option would not lead to an overall change in the number of people or property at risk of, or affected by, flooding, coastal inundation or sea level rise. • Option would result in development being sited in Flood Zone 1 (or equivalent) areas.
-	Negative	• Option would result in an increase in people or property at risk of, or affected by, flooding, coastal inundation or sea level rise. • Option would result in development being sited in Flood Zone 2 (or equivalent) areas.
--	Negative	• Option would result in a significant number of people or property affected by flooding, coastal inundation or sea level rise. • Option would result in development being sited in Flood Zone 3 (or equivalent) areas.

Effect	Description	Illustrative Guidance
?	Uncertain	• From the level of information available the effect that the option would have on this objective is uncertain.

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 6.3 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria[251]' and 'No NPS' on the flood risk and costal change objective. The appraisal considers in-turn the three sub-sections used for each topic within Chapter 5 (Impacts) of the draft NPS: Applicant's Assessment; Decision Making (subdivided into specific areas of interest) and Mitigation. The performance of the draft NPS and the two reasonable alternatives are scored accordingly, with a commentary provided in the Appraisal column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15 - 20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement. These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-term (less than 20 years), MT – medium-term (between 20 and 170 years) and LT – long-term (>170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

[251] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

Table 6.3 Appraisal of the Draft NPS and Reasonable Alternatives: Flood Risk and Coastal Change

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	**+**	**+/?**	**+/?**	**Draft NPS:** With specific regard to flood risk, the text in the draft NPS under the heading of the Applicant's Assessment (Paragraph 5.8.7) states that *"Applications for geological disposal surface infrastructure of one hectare or greater in Flood Zone 1 and all proposals for geological disposal surface infrastructure located in Flood Zones 2 and 3 should be accompanied by a site-specific flood risk assessment. A flood risk assessment will also be required where geological disposal surface infrastructure of less than one hectare may be subject to sources of flooding other than rivers and the sea (e.g. surface water, groundwater); or, where the Environment Agency has notified the local planning authority that there are critical drainage problems*." At paragraph 5.8.8, the draft NPS sets out that local flood risk management strategies and surface water management plans provide useful sources of information for flood risk assessments (FRAs) and that surface water flooding needs to be taken into account. The current text also notes that FRAs should identify and assess the risks of all forms of flooding to and from the infrastructure and demonstrate how these flood risks will be managed, taking climate change into account. Alongside guidance on the scope of an FRA, the draft NPS also sets out that applicants are advised to seek sufficiently early pre-application discussions with, inter alia, the Environment Agency and lead local flood authority to: identify the likelihood and possible extent and nature of the flood risk; help scope the FRA; and identify the information that will be required by the Secretary of State to reach a decision on the application. The introductory text of Chapter 5 of the draft NPS also notes that to avoid delay, applicants should discuss what information is needed with statutory environmental bodies as early as possible so to provide sufficient relevant information as part of the decision making process (including FRA). In respect of coastal change, the draft NPS (paragraph 5.8.14) states that "*Applications for development in a Coastal Change Management Area (CCMA) should make it clear why there is a need for it to be located in a Coastal Change Management Area. If this is the case, applicants should consult the local planning authority, Environment Agency and other relevant bodies on the scope of an assessment of the vulnerability of the proposed development to coastal change, to help demonstrate its appropriateness in such a location. This should take account of climate change, during the infrastructure's operational life and any decommissioning period*." The draft NPS also sets out that for any projects involving dredging, the applicant should consult the Marine Management Organisation (MMO) at an early stage. Similarly, for any projects which could impact on coastal change, the applicant should also consult the MMO. The current text stipulates that the applicant should examine the broader context of coastal protection around the proposed site and the influence in both directions i.e. coast on site and site on coast. The text then notes that the applicant should identify any effects of physical changes on the integrity and special features of Marine Conservation Zones, candidate marine Special Areas of Conservation (SACs), coastal SACs and candidate coastal SACs, coastal Special Protection Areas (SPAs) and potential coastal SPAs, Ramsar sites, Sites of Community Importance (SCIs) and potential SCIs and Sites of Special Scientific Impacts (SSSIs). The draft NPS highlights that, during the assessment of a new nuclear facility, the ONR will consider the applicant's safety case for protection against hazards such as flooding and coastal change and that any site specific elements that may impact safety should be justified by the applicant. The consideration of flood risk and coastal change in respect of scheme options will help to ensure that siting, design and mitigation measures are duly taken into account in the applicant's decision making process, that effects are fully identified and that appropriate mitigation measures are implemented. Overall, there are likely to be positive effects on flood risk and

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				coastal change. *Recommendations for Improvement* It is assumed that any GDF is designed in accordance with 'best available techniques' (BAT), the requirements of the 'groundwater directive' and other regulatory requirements to protect the environment (and in particular the water environment), as without this it could not obtain an Environmental Permit or begin operation. Consideration should also be given to providing further guidance on the possible contents of the ES with regards to flood risk and coastal change. Flood risk (and potentially coastal change) could be a key consideration in the assessment of site options and such considerations should be reflected within the Environmental Statement (ES). With specific regard to coastal change, it would be useful for the text to make direct reference to the PPG on the use of a vulnerability assessment of development in a CCMA (PPG Flood Risk and Coastal Change, Coastal Change Management Areas, Can a vulnerability assessment be used to demonstrate whether development is appropriate in a coastal change management area? Paragraph: 074 Reference ID: 7-074-20140306). Guidance on considering the requirements of a vulnerability assessment might demonstrate that the development[252]: • would not impair the ability of communities and the natural environment to adapt sustainably to the impacts of a changing climate; • will be safe through its planned lifetime, without increasing risk to life or property, or requiring new or improved coastal defences; and • would not affect the natural balance and stability of the coastline or exacerbate the rate of shoreline change to the extent that changes to the coastline are increased nearby or elsewhere.
				Draft NPS including Exclusionary Criteria: The effects of this reasonable alternative would be similar to those identified in respect of the draft NPS above. However, the setting of clear parameters for siting which excludes specific landscape, cultural and natural heritage assets could have a further positive effect as the exclusionary criteria will help to ensure that any flood risk and coastal change impacts associated with GDF-related NSIPs do not have adverse effects on designated nature conservation sites. However, any such impacts would be limited due to the range of assessments and mitigation measures outlined in the draft NPS and the additional beneficial effect is not considered to be significant. Unintended effects could be produced as a consequence of this alternative, such as greater pressure on development being located within areas of flood risk, although given existing national planning policy and the provisions of the draft NPS this would be unlikely.
				No NPS: DCO applications would be subject to the provisions of national planning policy and EIA Regulations under this reasonable alternative. It is also expected that local flood risk management plans and strategies would inform development proposals. However, the absence of a clear statement on the full range of considerations to be taken into account in respect

[252] DCLG (2015) Flood Risk and Coastal Change

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				of flood risk and coastal change (as proposed in the draft NPS) risks inconsistency in interpretation and unintended consequences through implementation. Overall, this reasonable alternative is considered to have a positive, albeit uncertain, effect against the flood risk and coastal change objective.
Decision Making	**+**	**+**	**+/?**	**Draft NPS:** Reflecting existing national planning policy, the draft NPS requires the application of the sequential test when assessing flood risk. If, following the sequential test, it is not possible for the project to be located in zones of lower probability of flooding than Flood Zone 3a, the exception test can be applied. The draft NPS (at 5.8.19) states that consent "*should only be granted for development in respect of deep boreholes where those boreholes are located in whole or in part in Flood Zone 3b where there are no other reasonable alternative locations. Whilst the surface infrastructure of a geological disposal facility should take account of Flood Zones, an applicant is not precluded from developing the underground parts of a geological disposal facility beneath Flood Zones*." Where development consent is sought on a site allocated in a development plan through the application of the Sequential Test, informed by a strategic FRA, applicants need not apply the sequential test for locating development within the site but should apply the sequential approach. The draft NPS (paragraph 5.8.24) stipulates that in determining an application for development consent, the Secretary of State should be satisfied that, where relevant: • the application is supported by an appropriate FRA; • the Sequential Test has been applied as part of site selection and, if required, the Exception Test as set out in the PPG supporting the NPPF; • a sequential approach has been applied at the site level to minimise risk by directing the most vulnerable development to areas of lowest flood risk, unless there are overriding reasons to prefer a different location; • in areas at risk of flooding, priority has been given to the use of sustainable drainage systems (SuDS); and • in flood risk areas, the infrastructure is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed over the lifetime of the development. For construction work which could have drainage implications, the draft NPS states that approval for the development's drainage system will form part of any development consent issued by the Secretary of State, who will expect SuDS to be put in place unless demonstrated to be inappropriate. At paragraph 5.8.26, the draft NPS makes clear that the Secretary of State will need to be satisfied, having regard to PPG and non-technical standards for SuDS, that the proposed minimum standards of operation are appropriate. Additionally, clear arrangements must be in place, through the use of planning conditions or planning obligations, for ongoing maintenance over the operational lifetime of the facility, including any necessary access rights to property. The Secretary of State must also be satisfied that the SuDs are designed to ensure that the maintenance and operational requirements are economically proportionate and that the most appropriate body is given the responsibility for maintaining any SuDs. Providing that the Secretary of State is satisfied that all reasonable steps have been taken by the applicant, and the Environment Agency or lead local flood authority to mitigate risks, the draft NPS stipulates that consent can be granted for development. With specific regard to coastal change, the draft NPS (Paragraph 5.8.29) states that "*When assessing applications in a Coastal Change Management Area, the Secretary of State should not grant development consent unless it is demonstrated*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				that: • *the development will be safe over its planned operational lifetime and will not have an unacceptable impact on coastal change;* • *the character of the coast (including designations) is not compromised;* • *the development provides wider sustainability benefits; and* • *the development does not hinder the creation and maintenance of a continuous, signed and managed route around the coast.*" The draft NPS also states that essential infrastructure may be granted development consent in a CCMA provided that there are clear plans to manage the impacts of coastal change on it and will not have an adverse impact on rates of coastal change elsewhere. The Secretary of State must also have regard to the appropriate marine policy documents and may have regard to relevant shoreline management plans in taking any decision which relates to the exercise of any function capable of affecting any part of the UK marine area. However, if there is conflict between the draft NPS and these plans, the draft NPS prevails. Overall, the draft NPS is expected to have a positive effect on this objective due to the direction given to the Secretary of State to consider flood risk and coastal change when assessing development proposals (in the context of existing plans and strategies on flood risk and coastal change) and to give priority to the use of SUDS and resilience, which is consistent with existing national planning policy and guidance. At paragraph 5.8.32, the draft NPS makes clear that substantial weight should be attached to the risks of flooding and coastal erosion. The applicant must demonstrate that a full account has been taken of the policy on the assessment and mitigation in the draft NPS, taking account of the potential effects of climate change on these risks.
				Draft NPS including Exclusionary Criteria: Setting clear exclusionary criteria for siting which specifically excludes landscape, cultural and natural heritage assets, including SPAs and SACs, would help to ensure that flood risk and coastal change arising from GDF-related infrastructure would not have adverse effects on these sites/assets. However, any such impacts would be limited due to the range of assessments and mitigation measures outlined in the draft NPS and the additional beneficial effect is not considered to be significant. As noted above, unintended effects could be produced as a consequence of this alternative, such as greater pressure on development being located within areas of flood risk, although given existing national planning policy and the provisions of the draft NPS this would be unlikely.
				No NPS: Under this alternative, DCO applications will be subject to the provisions of national planning policy and EIA Regulations which would have a positive, albeit uncertain, effect against the flood risk and coastal change objective. The uncertain effects arise from, inter alia, the absence of clear statements on the role of the Secretary of State when assessing the location of development, the inclusion and use of an appropriate FRA, sequential and exception testing, SuDS and reasons for refusing development consent (as proposed in the draft NPS).
Mitigation	**+/?**	**+/?**	**+/?**	**Draft NPS:** With regard to flood risk, the draft NPS sets out at paragraphs 5.8.33 and 5.8.34 that "*To satisfactorily manage flood risk and the impact of the natural water cycle on people, property and ecosystems, good design and infrastructure may need to be secured through use of planning requirements or obligations. These may include the use of sustainable drainage*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				systems and the planting of vegetation to help to slow run-off, hold back peak flows and make landscapes more able to absorb the impact of severe weather events. Surface based aspects of geological disposal infrastructure which has to be located in flood risk areas should be designed to remain operational when floods occur." The proposed mitigation measures contained in the draft NPS also include the preparation and use of flood warning and evacuation plans for those areas identified as at risk of flooding. It is stipulated that the applicant seeks advice from the emergency services when preparing an evacuation plan as part of the FRA. Any emergency planning documents, flood warning and evacuation procedures that are required should be identified in the FRA (paragraph 5.8.35). The Secretary of State is required to consider whether the applicant has made suitable proposals to mitigate flood risk (paragraph 5.8.36) and where necessary, appropriate requirements should be attached to any development consent or planning obligations entered into. The draft NPS makes clear that the Secretary of State should only grant development consent where the arrangements to mitigate flood risks are acceptable. In terms of coastal change, the draft NPS sets out that applicants should propose adequate mitigation measures to address adverse physical changes to the coast in consultation with, inter alia, the MMO, the Environment Agency and local planning authorities. If necessary, the draft NPS states that appropriate requirements should be attached to any development consent or planning obligations entered into and that the Secretary of State should only grant development consent where the arrangements to mitigate any adverse physical changes to the coast are acceptable. The Secretary of State should also ensure development within a CCMA is not impacted by coastal change by limiting the planned life-time of the proposed development of surface-based facilities where appropriate. This could be done through temporary permission and restoration conditions where necessary to reduce the risk to people and the development (Paragraph 5.8.38). This has been assessed as having a positive, albeit uncertain, effect on the objective. It should be noted that the Radioactive Waste Management Ltd (2016) Geological Disposal Generic Environmental Assessment Report highlights that any GDF would be designed in accordance with 'best available techniques' (BAT). This means that, as a matter of course there would be facilities to attenuate any surface water run-off, preventing any increase in flood risk. Further, site selection work will ensure that there is a good understanding of hydrological conditions, including groundwater movement and flood risk, prior to construction commencing. *Recommendations for Improvement* The mitigation measures identified in the draft NPS could be revised to be more specific and clearly reflect the potential effects associated with the key project stages of site investigation, construction, operation and closure, as summarised below[253]. *Siting* Adverse effects on flood risk and costal change during the siting process would mainly arise as a result of increased flood risk due to: siltation of local watercourses; rapid run-off from impermeable areas of the development; or restricting flow at new culverts. However, the risk of occurrence can be reduced to an insignificant level through good site design, good construction practice, good environmental management and flood alleviation measures where required in line with the results

[253] Derived from: Radioactive Waste Management Ltd (December 2016) *Geological Disposal Generic Environmental Assessment*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				of a FRA (although the risk of an unforeseen incident would remain). Temporary flood control measures would also be required at drill sites. It is expected that a GDF would include facilities to attenuate surface water run-off such as SuDS, thereby minimising any increase in flood risk. This is assumed to be part of a basic GDF design, rather than a specific mitigation measure. The effect of such standard controls is that an adverse effect on the water environment that would otherwise be hypothetically possible has been eliminated, as it would not occur in any development carried out responsibly and in accordance with regulatory requirements. However, consideration could be given to the inclusion of mitigation measures in the draft NPS including: • Incorporate protection/treatment of run-off to avoid siltation of watercourses where necessary. • Ensure watercourse crossing numbers are minimised and flood and pollution control measures incorporated where crossings are required. • Achieve attenuation to greenfield rates of run-off and no increase in run-off volumes where possible. The Radioactive Waste Management Ltd (2016) Geological Disposal Generic Environmental Assessment Report highlights that opportunities may exist at borehole drilling locations to reduce the risk of flooding. *Construction* Site clearance, levelling and the use of hardstanding areas could affect surface water flows, rates of infiltration and potentially affect groundwater recharge rates. The mobilisation of sediment from soil and aggregate bunds could result in siltation of water courses as a result of rainfall run-off, flows and if water courses are located in close proximity to the bunds. Additional mitigation measures during operation could include: • New construction-phase environmental management plan(s). • Construction site and permanent drainage to incorporate SuDS, with surface storage and attenuation to greenfield rates with no increase in run-off volume where possible. • Plan works to minimise duration of dewatering requirements. • Cover excavated rock, especially lower strength sedimentary rock, rapidly with soil, to prevent risk of siltation. *Operation & Closure* Adverse effects identified during the operation and closure phase relate to the potential effects of ongoing excavation works on the localised water regime, including the obstruction of groundwater flows in aquifers on a localised scale, e.g. grouting/lining in the drift, shafts and tunnels acting as a barrier to normal flow patterns, or groundwater monitoring and control modifying flow patterns with effects on the water regime during the closure phase being of a similar, or lesser, scale and nature to those in the operational phase. In addition to the continuation of the above mitigation measures, additional mitigation measures during operation and closure could include: • New, operational phase environmental management plan(s). • Site restoration should ensure a similar surface run-off regime to that originally present, allowing for any other changes in the surrounding environment in the intervening decades (unless an alternative end state is agreed with

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				the local community).
				Draft NPS including Exclusionary Criteria: The specification of exclusionary criteria is unlikely to make a difference to the application of the mitigation and enhancement measures as set out for the draft NPS above, and as such the predicted effects are likely to be similar.
				No NPS: Appropriate mitigation measures will be considered by the competent authority in light of the proposals submitted. As such, mitigation measures will be applied but there is the risk that this is open to interpretation and thereby does not fully address an appropriate range of activities which are directly related to the scheme.
Other Sections of the Draft NPS Relevant to Flood Risk and Coastal Change	**1. Introduction** 1.1.3 Provision is made for the consideration of effects of DCO obligations and their impact on the local authority's area in a specific locality through the requirement that a local impact report be submitted by a local authority in accordance with the Planning Act. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on flood risk and coastal change as an issue, helping to ensure that consideration is given to likely effects in a particular locality. 1.1.5 Consideration of the effects on flood risk and coastal change is reflected in the need to apply the draft NPS in the context balancing adverse impacts and benefits. The net result of this balancing exercise could be uncertain, however. 1.1.7 The generic impacts considered in the draft NPS, along with the application of the draft NPS as a material consideration on a case by case basis, could result in uncertainty over what provisions will be applied in respect of the consideration of flood risk and coastal change and the mitigation of adverse effects. **1.4 Consideration of deep boreholes investigations** – the role and content of an ES, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of flood risk and coastal change impacts, avoiding or reducing harm and providing appropriate mitigation measures where required. **1.5 Consideration of geological disposal facilities** - no direct relationship identified. **2. Government Policy on Management of Higher Activity Radioactive Waste** 2.2.6. The preference for disposal through a single site will help to confine effects to a specific area thus limiting effects on flood risk and coastal change, although these would be greater in a single location and could still be significant in respect of a particular site, dependent on the characteristics of the flood zones and coastal issues of the host area. 2.4.3 The strategy for implementation provides for the opportunity to consider flood risk and coastal change as the process proceeds iteratively, including discussions with communities of interest. **3. The Need for Geological Disposal Infrastructure** Section 5(8) of the Planning Act requires that the policy set out in the NPS takes account of Government policy relating to the mitigation of, and adaptation to, climate change, including flood risk and coastal change. **4. Assessment Principles**			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	4.1 General principles of assessment – the scale of NSIPs could lead to significant impacts on the environment, the economy and communities. The provisions of the Planning Act and the policies and protections set out in the draft NPS provide for a balanced consideration of impacts and benefits. The requirement for the identification of positive and adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for consideration of flood risk and coastal change issues. This section also provides detail on the principles against which the application should be judged in relation to design, environmental, health, safety and security aspects, as noted in Table 1. **4.2 Environmental Impact Assessment**– the consideration of proposals within the EIA Regulations and the preparation of an ES (where required) agreed by statutory agencies and specifying mitigation measures and enhancement measures will ensure that flood risk and coastal change impacts are fully considered, as will the consideration of cumulative effects and interrelationships between effects. **4.3 Habitats Regulations Assessment** – no direct relationship identified. **4.4 Alternatives** – the identification that reasonable alternatives will be required as part of scheme design and project planning should ensure that flood risk and coastal change impacts are taken into account, both in terms of protection and opportunities for mitigation and enhancement. **4.5 Criteria for 'good design' for geological disposal infrastructure** – applying 'good design' to geological disposal projects should produce sustainable infrastructure sensitive to place, efficient in the use of natural resources and energy used in their construction. A good design should meet the principal objectives of the scheme by eliminating or substantially mitigating the significant impacts, by improving operational conditions and simultaneously minimising adverse impacts. Good design, in terms of siting and use of appropriate technologies, can help mitigate adverse impacts, including flood risk and coastal change. **4.6 Climate Change Adaptation** – the Planning Act requires the Secretary of State to have regard to the desirability of mitigating, and adapting to, climate change, including flood risk and coastal change, in designating and reviewing an NPS. Adaptation of development is necessary to deal with the potential impacts of climate change over the operational lifetime of the GDF. Applicants must consider the impacts of climate change when planning the location, design, build, operation and decommissioning and final closure of a GDF. The ES should set out how the proposal will take account the projected impacts of climate change. The Secretary of State must be satisfied that there are no features of the design of any geological disposal infrastructure, critical to its safe operation, which may be seriously affected by more radical changes to the climate beyond that projected. Where adaptation measures are necessary to deal with the impact of climate change, and those measures would have an adverse effect on other aspects of the project and/or surrounding environment, the Secretary of State may require the applicant to implement adaptation measures should the need arise, rather than at the outset of development. **4.7 Pollution Control and other Environmental Regulatory Regimes** – no direct relationship identified. **4.8 Common Law Nuisance and Statutory Nuisance** – no direct relationship identified. **4.9 Safety** – no direct relationship identified. However, the impacts of flooding and coastal change will be an important consideration in determining the safety of a scheme. **4.10 Health** –where the proposed development has an effect on human health, the ES should assess these effects for each element of the project, including flood risk and coastal change, identifying any adverse health impacts and mitigation measures to avoid, reduce or compensate for such impacts as appropriate. **4.11 Security Considerations** – no direct relationship identified. **Section 5 (other topics)** – it should be noted that there are links between flood risk and coastal change and other topics contained in Section 5 of the draft NPS including, in particular, water quality. It is anticipated that this topic will generate further positive effects in respect of this objective.			
Summary Appraisal of Likely Significant	**+**	**+**	**+/?**	**Draft NPS:** Climate change over the operational lifetime of a GDF could lead to an increase in flood risk in areas susceptible to flooding. The NPPF aims to avoid inappropriate development in areas at risk of flooding but where development is necessary, the use of policy aims to make it safe without increasing flood risk elsewhere. Similarly, where surface facilities or deep boreholes are proposed near the coast, coastal change is a key consideration. The draft NPS seeks to identify and

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Effects				assess the risks of flooding and coastal change and how these will be managed, taking climate change into account. It stipulates that the Secretary of State can refuse consent in Flood Zones 2 and 3 if the sequential and exception test, respectively, have not been satisfactorily applied which will help to avoid inappropriate development in areas of flood risk. The Secretary of State may grant development consent in a CCMA provided that there are plans to manage the impacts of coastal change on it and it will not have an adverse impact of rates of change elsewhere which should help to avoid development in areas affected by coastal erosion and not affect coastal processes and erosion rates. Overall, the draft NPS attaches substantial weight to the risks of flooding and coastal change. It seeks to reduce the effects of flood risk and coastal change on the natural environment, life and property through the effective design and location of development. This, alongside other requirements set out in the draft NPS, existing national planning policy, local flood risk management plans and strategies and guidance will help to minimise direct and indirect effects with respect to flood risk and coastal change and has therefore been assessed as having a positive effect on this objective.
				Draft NPS including Exclusionary Criteria: Positive effects on flood risk and coastal change associated with this reasonable alternative are expected to be broadly similar to those identified in respect of the draft NPS above. However, the setting of clear parameters for siting which excludes specific landscape, cultural and natural heritage assets are considered likely to yield positive effects as the exclusionary criteria will help to ensure that flood risk and coastal change impacts associated with GDF-related NSIPs do not have adverse effects on key assets. Unintended effects could be produced as a consequence, such as greater pressure on development being located within areas of flood risk, although given existing national planning policy and the provisions of the draft NPS this would be unlikely.
				No NPS: Despite the absence of a guiding framework for flood risk and coastal change impacts, this reasonable alternative is likely to result in positive effects overall as any development would be subject to the provisions of national planning policy and EIA Regulations and would be likely to take into account local flood risk management plans and strategies and guidance. However, the absence of a clear statement on the role of the Secretary of State when assessing the location of development in particular risks inappropriate development being considered. It is acknowledged that whilst mitigation measures would be forthcoming under this alternative, there is a risk that these are not comprehensive or consistent and may not fully address any effects arising.
Summary of Recommending Mitigation and Enhancement	The draft NPS already sets out a number of measures to address impacts associated with flood risk and coastal change. However, it is considered that this mitigation could be revised to be more specific and clearly reflect the key project stages of site investigation, construction, operation and closure. Further, the draft NPS could stipulate guidance relating to the contents of a vulnerability assessment, as required for development within Coastal Change Management Areas. Consideration could also be given to providing further guidance on the possible contents of the ES with regards to flood risk and coastal change.			

7. Air

Introduction

This section presents the overview of plans, programmes and baseline information and the appraisal of sustainability of the National Policy Statement for Geological Disposal Infrastructure and reasonable alternatives in respect of air quality.

Air quality within this context concerns the levels of pollutants emitted into the air and their significance, in terms of the risk of adverse effects on the environment and/or human health. Carbon dioxide (CO_2) and other greenhouse gas emissions are excluded from the air quality topic and are reported under the climate change topic.

There are links between the air quality topic and other topics in the Appraisal of Sustainability (AoS) including biodiversity and nature conservation, human health, climatic factors and traffic and transport.

Review of Plans and Programmes

Whilst not directly commenting on geological disposal facilities, the regulations provide the legislative context to ensure that risks to air quality, particularly during the construction phase of any development, are minimised.

International/European

The ***Ambient Air Quality and Cleaner Air for Europe Directive (2008/50/EC)*** consolidated earlier air quality directives and also defines and establishes objectives and targets for ambient air quality to avoid, prevent or reduce harmful effects on human health and the environment as a whole. It sets legally binding limits for concentrations in outdoor air of major air pollutants that impact on public health such as particulate matter (PM_{10} and $PM_{2.5}$) and nitrogen dioxide (NO_2). The 2008 Directive replaced nearly all the previous EU air quality legislation and was implemented in England through the ***Air Quality Standards Regulations 2010*** (SI 2010/1001), which also incorporates the 4th air quality daughter ***Directive 2004/107/EC*** that sets targets for levels in outdoor air of certain toxic heavy metals and polycyclic aromatic hydrocarbons. Equivalent regulations exist in Scotland (***The Air Quality Standards (Scotland) Regulations 2010*** (SSI 2010/204) and Wales (***The Air Quality Standards (Wales) Regulations 2010*** (WSI 2010/1433).

Following a review of EU air quality policy, the EU published the ***Clean Air Policy Package*** in 2013 with new proposals on ambient air quality and emissions ceilings. The package included a new ***Clean Air Programme for Europe (2013),*** which set out new air policy objectives for 2030 to reduce health impacts and eutrophication in ecosystems. The package will also involve revisions to the National Emissions Ceiling Directive.

The objectives of the Clean Air Programme have been enacted via ***Directive 2016/2284/EU*** on the reduction of national emissions of certain atmospheric pollutants, which entered into force on 31 December 2016. This Directive sets national reduction commitments for the five pollutants (sulphur dioxide, nitrogen oxides, volatile organic compounds, ammonia and fine particulate matter) responsible for acidification, eutrophication and ground-level ozone pollution which leads to significant negative impacts on human health and the environment. It repealed

and replaced Directive 2001/81/EC, the National Emission Ceilings Directive (NEC Directive) from the date of its transposition (30 June 2018).

The ***Industrial Emissions Directive (IED) (2010/75/EU)*** combines seven existing air pollution directives, including the Large Combustion Plant Directive and the Integrated Pollution Prevention and Control (IPPC) Directive. As with previous directives aimed at minimising emission release, part of the benefit of the IED is that it includes several new industrial processes, sets new minimum emission limit values (ELVs) for large combustion plant and addresses some of the implementation issues of the IPPC.

The UK monitors and models air quality to assess compliance with the air quality limit and target values set out in the EU legislation above. The results of the assessment are reported to the Commission on an annual basis. Air quality monitoring is also carried out by local authorities to meet local air quality management objectives.

UK

Air quality is a devolved matter, though the UK Government leads on international and European legislation. Part IV of the ***Environment Act 1995*** sets provisions for protecting air quality in the UK and for local air quality management. It requires local authorities to undertake local air quality management (LAQM) assessments against the standards and objectives prescribed in regulations. Where any of these objectives are not being achieved, local authorities must designate air quality management areas and prepare and implement remedial action plans to tackle the problem.

The ***Air Quality Standards Regulations 2010*** (SI 2010/1001) and transposed into English law the requirements of Directives 2008/50/EC and 2004/107/EC on ambient air quality. Equivalent regulations have been made by the devolved administrations in Scotland (***The Air Quality Standards (Scotland) Regulations 2010*** (SSI 2010/204) and Wales (***The Air Quality Standards (Wales) Regulations 2010*** (WSI 2010/1433). The objective of the Regulations is to improve air quality by reducing the impact of air pollution on human health and ecosystems. The standards set out air quality objectives, limit values and target values for pollutants, namely benzene, 1,3 butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide, PM_{10}, and $PM_{2.5}$.

The ***Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007)*** sets out a way forward for work and planning on air quality issues.

The ***Ozone-Depleting Substances Regulations 2015*** (SI 2015/168) introduces controls on the production, use and emissions from equipment of a large number of ‘controlled substances’ that deplete the ozone layer.

The ***Environmental Permitting (England and Wales) Regulations 2016*** (SI 2016/1154) sets up a pollution control regime. The environmental regulator would specify conditions for environmental permits, for example limiting the type and quantity of emissions released to air.

The ***Local Air Quality Management: Technical Guidance (TG 16) 2016*** sets out the technical guidance and approach for local authorities to carry out their responsibilities under the Environment Act 1995, the Environment (Northern Ireland) Order 2002, and subsequent regulations. This includes their responsibility to monitor, assess and take action to improve local air quality including Air Quality Management Areas[254].

[254] Defra (2016) *Local Air Quality Management: Technical Guidance (TG 16)*. Available online at:

In July 2017 the UK Government has published the ***UK plan for tackling roadside nitrogen dioxide concentrations***. It sets out the UK Government's plan for bringing nitrogen dioxide air pollution within statutory limits in the shortest possible time as it is the only statutory air quality limit that the UK is currently failing to meet. This is important for water courses and soils as NO_2 contributes to acidification and eutrophication.

England

The ***National Planning Policy Framework (Department for Communities and Local Government, 2012)*** expects the planning system to prevent new development from contributing to unacceptable levels of air pollution. Planning policies and decisions are therefore expected to ensure that new development is appropriate for its location and take into account "*The effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution*" (paragraph 120).

The Framework expects planning policies to "*sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan*" (paragraph 124). In doing so, local planning authorities are expected to focus on whether the development itself is an acceptable use of the land, and the impact of the use, rather than the control of processes or emissions themselves where these are subject to approval under pollution control regimes.

Planning Practice Guidance relating to Air Quality[255] provides guiding principles on how planning can take account of the impact of new development on air quality. The guidance provides information a range of topics including why planning should be concerned about air quality, the role the local plan has in regards to air quality, what information is available about air quality and when air quality could be relevant to a planning decision.

Scotland

The purpose of the ***Scottish Planning Policy (SPP) (2014)*** is to set out national planning policies which reflect Scottish priorities for operation of the planning system and for the development and use of land. It highlights the important role that planning has in realising sustainable development and protecting natural heritage, including air. In addition to this, ***Scotland's Third National Planning Framework (2014)*** is the spatial expression of the Government Economic Strategy and Scottish plans for infrastructure investment. It notes that air quality can be improved through reducing the impact of transport on city and town centres and the significant health benefits this would bring.

The Scottish Executive's ***Air Quality and Land Use Planning (2004)*** guidance outlines some of the main ways in which land use planning can help deliver air quality objectives.

Cleaner Air for Scotland: The Road to a Healthier future (2015) is the national strategy that sets out how the Scottish Government and its partner organisations propose to reduce air pollution further to protect human health and fulfil Scotland's legal responsibilities as soon as possible.

https://laqm.defra.gov.uk/documents/LAQM-TG16-April-16-v1.pdf

[255] DCLG (2014) *Planning Practice Guidance: Air quality.* Available online at: https://www.gov.uk/guidance/air-quality--3

Delivering Cleaner Air for Scotland – Development Planning & Development Management (2017) presents guidance from Environmental Protection Scotland and the Royal Town Planning Institute Scotland the tailors the UK-wide approach to planning and air quality protection to be relevant for the Scottish planning system and associated air quality objectives.

Wales

The ***Air Quality Standards (Wales) Regulations 2010*** bring into law in Wales the limits set out in European Union (EU) Daughter Directives on Air Quality. The regulations require that Welsh Ministers divide Wales into air quality zones.

The ***Well-being of Future Generations (Wales) Act 2015*** requires public bodies including the Welsh Government to carry out and contribute to sustainable development. At the national level, the Welsh government have published 46 national indicators for wales, which includes 'Levels of nitrogen dioxide (NO_2) pollution in the air' (Indicator No. 4).

Planning Policy Wales (Edition 9) (2016) sets out the land use planning policies of the Welsh Government. Regarding air quality, Planning Policy Wales sets out potential material planning considerations in relation to: location and site selection; impact on health and amenity; the risk and impact of potential pollution from the development as well as the effect of the surrounding environment; the prevention of nuisance; and the impact on the road and other transport networks.

In June 2017 the Welsh Government published **Local Air Quality Management in Wales 2017** which provides policy guidance on the overall approach to local air quality management in Wales.

Overview of the Baseline

UK

The UK is compliant with its 2010 national emission ceilings for air pollutants. National emissions totals each year for the main pollutants are reported to the European Commission.

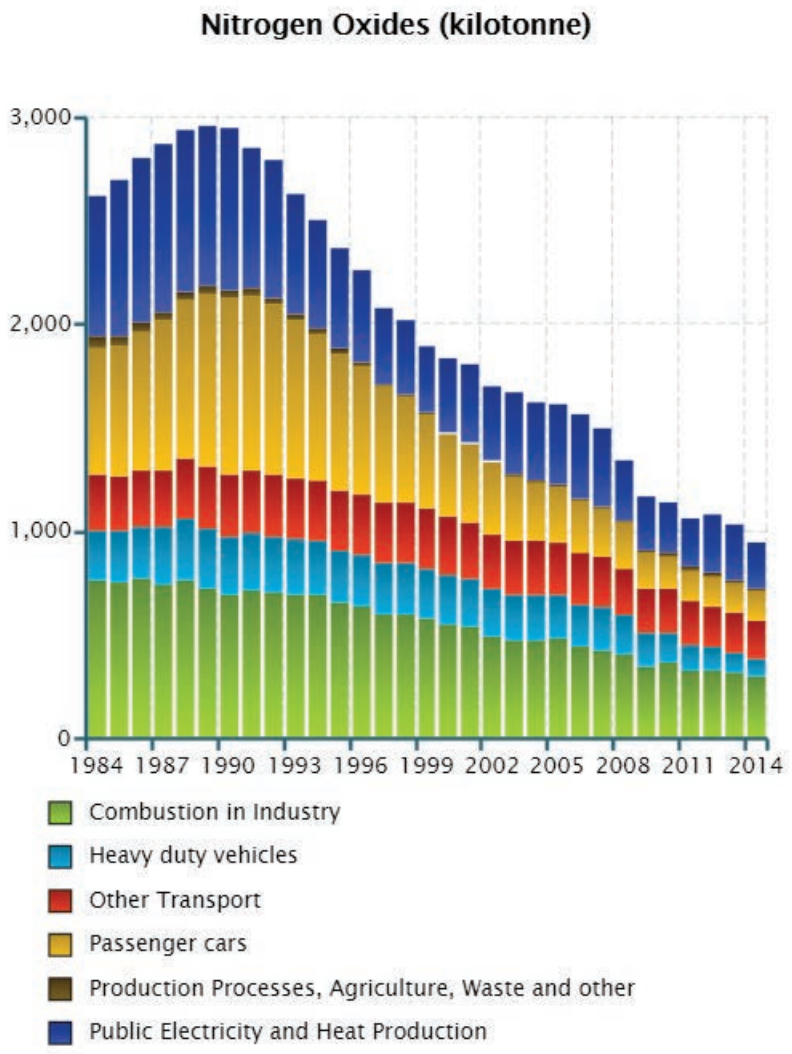
In 1990 UK emissions of Nitrogen Oxide (NO_x) (as NO_2) were 2.7 Mt. These have reduced to 1.1 Mt in 2011 and continued to reduce up to the latest 2014 data from the National Atmospheric Emissions Inventory, as shown in **Figure 7.1**[256]. This has largely been due to abatement measures for road transport and at coal-fired power stations.

Sulphur dioxide (SO_2) emissions in the UK have reduced from 3.7 Mt in 1990 to 0.4 Mt in 2007. This is largely due to the decrease in the use of coal and use of increasingly effective abatement[257].

[256] National Atmospheric Emissions Inventory (2017) *About Nitrogen Oxides*. Available online at: http://naei.defra.gov.uk/overview/pollutants?pollutant_id=6

[257] Defra (2011) *AQPI Summary Report: Emissions of Air Quality Pollutants – 1970-2011.* Available online at: https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1305031312_EoAQP1970-2011_pg.pdf

Figure 7.1 Estimated Annual UK Emissions of Nitrogen Oxides (kt)



Source: National Atmospheric Emissions Inventory

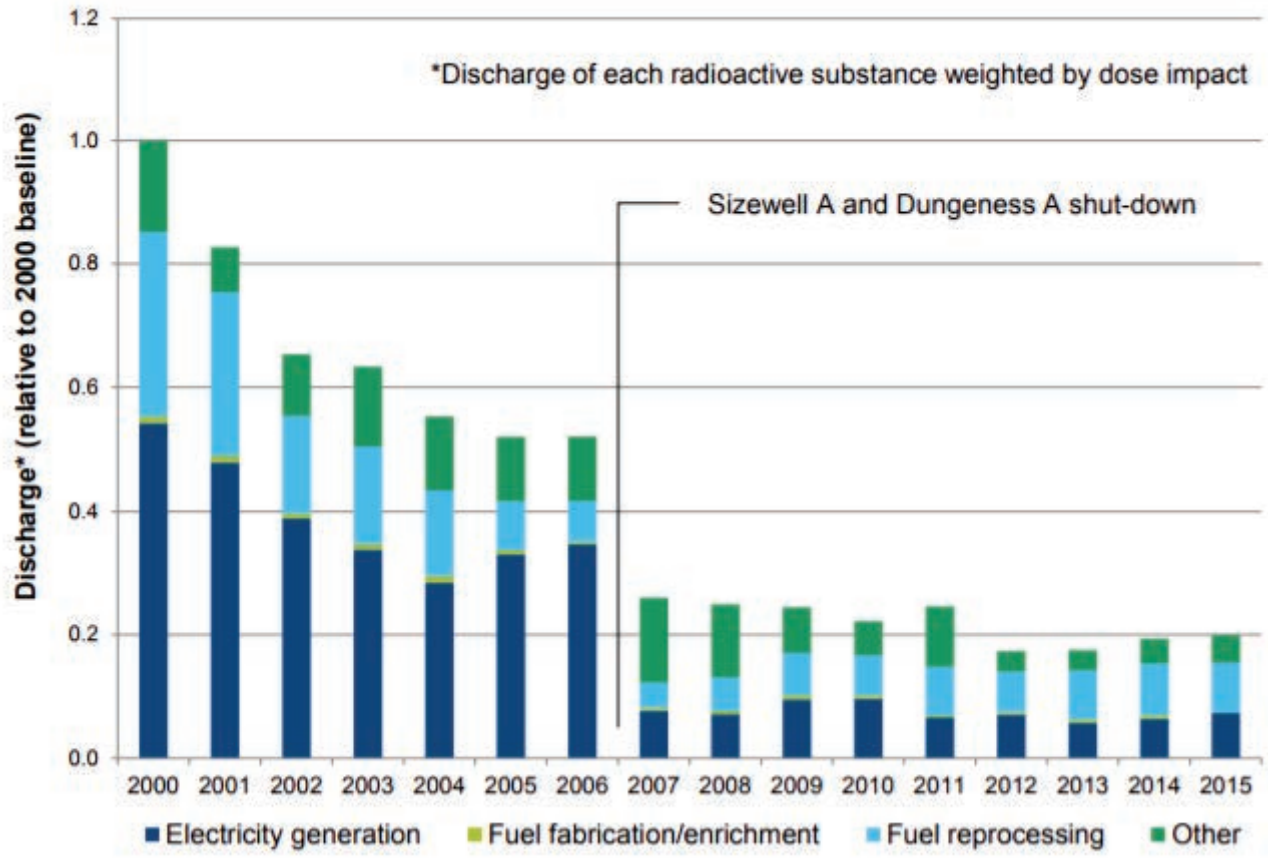
Urban background and roadside particulate pollution has shown long-term improvement however small increases in concentration are observed from 2015 to 2016 for roadside sites. There is some year-on-year variability with a long-term downward trend in urban background and roadside particulate pollution. For background sites the concentration of particulate pollution was similar in 2015 and 2016[258].

In 2017, 254 Local Authorities in the UK had declared Air Quality Management Areas (AQMAs), a designation made by a Local Authority where an assessment of air quality results in the need to devise an action plan to improve the quality of air[259]. AQMAs are predominantly in urban areas along busy and congested road networks and are generally related to nitrogen dioxide (NO_2) (in 93% of cases), with and particulates (PM_{10}) featuring in 6% of cases and SO_2 in 1%. Transport is identified as the main source of pollution in the clear majority of all AQMAs.

[258] Defra (2017) National Statistics Release: Air quality statistics in the UK, 1987 to 2016. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/610927/Air_Quality_National_Statistic_apr17_FINAL.pdf
[259] AQMAs interactive map available at: https://uk-air.defra.gov.uk/aqma/maps

Figure 7.2 shows the total nuclear sector discharge to atmosphere weighted by potential dose impact ('radiotoxicity') using standard values of dose per unit inhaled and divided by the value obtained in 2000.

Figure 7.2 Total assessed radioactive discharges to air



Source: Nuclear Sector Plan 2015 Environmental Performance Report

Gaseous discharges weighted by dose impact increased by 2.9% compared with 2014 levels, due largely to emissions associated with the electricity generation sub-sector, which were 16.2% higher in 2015 than in 2014. Nonetheless it is clear that, since the year 2000, discharges have decreased by approximately 80%.

England

As of 2017 there are 221 local authorities in England with Air Quality Management Areas (AQMAs), 33 of which were within London[260]. As many Local Authorities have multiple AQMAs, there are a total of 626 AQMAs in England. Most AQMAs in England (and the UK as a whole) are in urban areas and result from traffic emissions of nitrogen dioxide or PM_{10}. Emissions from transport (road and other types) are the main source in 97% of the AQMAs declared for NO_2; only a few have been declared as a result of other sources, such as industrial or domestic emissions.

[260] AQMAs interactive map available at: https://uk-air.defra.gov.uk/aqma/maps

Scotland

As of 2017 there are 14 Local Authorities in Scotland with a declared AQMA[261]. Air quality annual mean air quality trend data up to and including 2014 shows that with regards to NO_2 at urban background monitoring sites there is a decreasing trend year-on-year, albeit the decrease is relatively small. For traffic related monitoring sites the is a greater variation in trends, with four of the nine monitoring sites showing a downward trend, one site showing an upward trend and four sites showing no significant trend. As such it is considered that concentrations of this pollutant depend greatly on conditions at the various sites.

Urban background PM_{10} concentrations were shown to be reducing at all four monitoring stations. PM_{10} concentrations were also reducing at the urban traffic sites. Annual mean trends for $PM_{2.5}$ vary between the 5 monitored sites, with two showing a clear upward trend, one showing a clear downward trend and two showing no significant change. Rural concentrations of zone have shown a minor upward trend, with urban concentrations reducing[262].

Wales

Air quality in Wales continues to improve year on year and both emissions and ambient concentrations of key pollutants are decreasing, though annual average concentrations across the country have started to level out in recent years.

Urban air quality in Wales is generally worse than in rural areas. The main causes of pollution at urban sites are fine particles (PM_{10}) and ozone (O_3). The main cause of pollution in rural areas is the variation in ozone levels, which is affected by the weather. Four Welsh monitoring sites (Rhondda Mountain Ash, Caerphilly Hafodyrynys, Newport M4 Junction 25 and Swansea Station Court High Street) exceeded the annual mean objective of 40 µg m-3 for NO_2. Caerphilly Hafodyrynys and Rhondda Mountain Ash also exceeded the AQS Objective for hourly mean NO_2 concentration on more than the permitted 18 occasions in 2015. One site in Wales exceeded the AQS Objective for O_3 (100 µg m-3 as a maximum daily 8-hour mean) on more than the permitted 10 occasions. This was Pembroke Power Station[263].

As of 2017, there are 10 Local Authorities with a declared AQMA[264]. There are 26,353 people living in AQMAs in Wales, representing 0.9% of the total population.

Summary of Existing Problems Relevant to the Geological Disposal NPS

The following existing problems for air quality have been identified:

- Poor air quality is generally associated with urban/industrial areas and major road infrastructure. A relatively large number of AQMAs are located in in urban areas, many of which have been designated due to high NO2 and PM10 levels.
- Historical emissions have resulted in high levels of sulphur and nitrogen deposits in wetter parts of the UK such as northern England and the Welsh uplands. This has resulted in acidification and nitrogen eutrophication in some areas. Around a third of the UK land area is sensitive to acid deposition and a third to eutrophication. By

[261] Ibid
[262] http://www.scottishairquality.co.uk/data/trends
[263] Welsh Assembly Government & Welsh Air Quality Forum (2015) *Air pollution in Wales 2015*. Available online at: http://www.welshairquality.co.uk/documents/reports/507161019_AQ_wales_2015_v12_Press.pdf
[264] Ibid

2010, the percentage of sensitive habitat area where acid deposited exceeded critical load was 49%. Similarly, 68% of sensitive habitat area exceeded the critical load as a result of nitrogen[265].

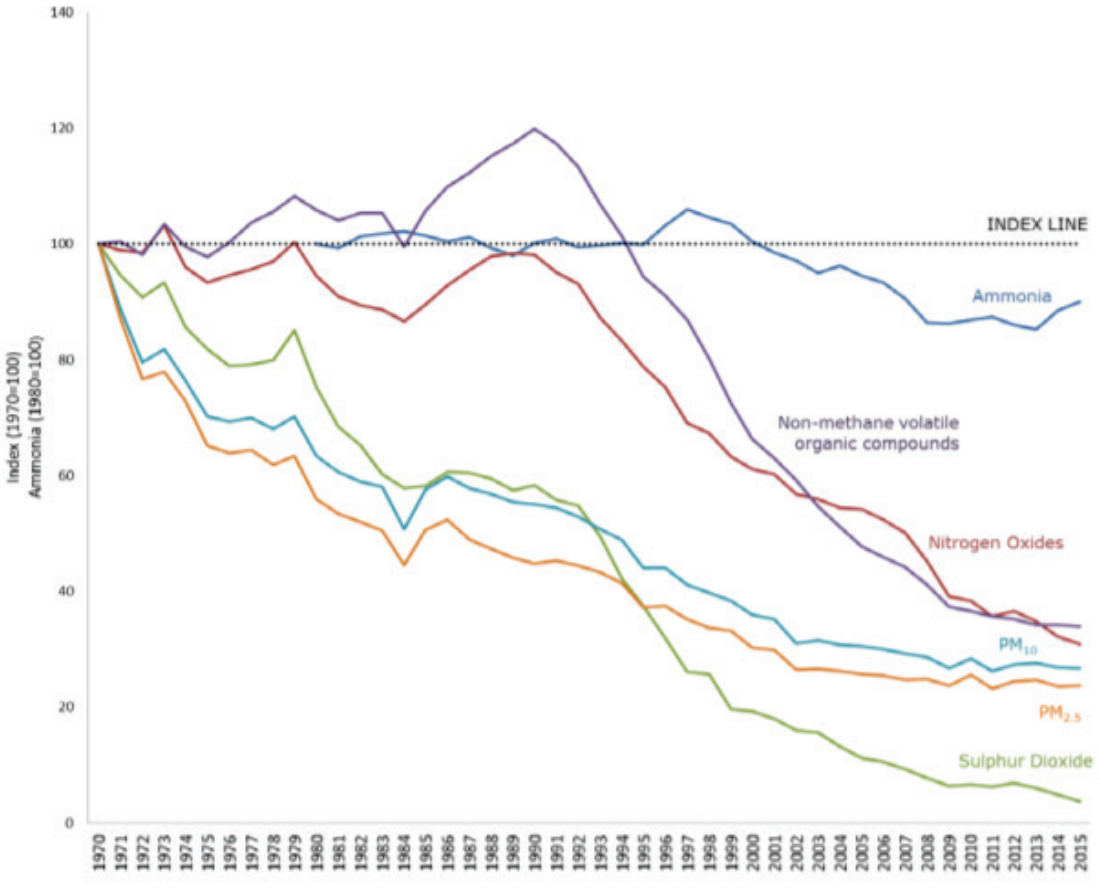
Likely Evolution of the Baseline

UK

Figure 7.3 identifies the trends in in UK sulphur dioxide, nitrogen oxides, non-methane volatile organic compounds, ammonia and particulate matter (PM_{10}, $PM_{2.5}$) emissions from 1970 to 2015.

This is further evidenced by the NOx modelling undertaken for roads directly managed by local authorities and Transport for London. This projected trend did not take into account the effects of the plans itself. The data shows all local authorities achieving the statutory limit for NO_2 by 2025, except for Greater London, which would take a further 3 years[266].

Figure 7.3 UK air quality trend data



The index line is a comparator that shows the level of emissions if they had remained constant from the beginning of the time series.

[265] Joint Nature Conservation Committee (2014) *Air Pollution Bulletin*. Available online at: http://jncc.defra.gov.uk/pdf/Air_pollution_bulletin2_2014.pdf

[266] Defra and the DfT (2017) *UK plan for tackling roadside nitrogen dioxide concentrations*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/633270/air-quality-plan-detail.pdf

Source: Defra

Based on this trend data and in the context of increasingly restrictive legislation with regards to key sources of air pollution, such as from road transport and energy generation, it is reasonable to predict a continued improvement in air quality over time in accordance with the UK Informative Inventory Report (1990 to 2015)[267].

England

PM_{10} pollution overall has been decreasing in recent years and this is predicted to continue in the future. By 2015, 71.7km of main urban road is predicted to be in exceedance of 31.5µg/m^3 (roughly equivalent to the Stage 1 PM_{10} 24-hour limit value and objective), this is a 96.7% decrease compared to the 2003 baseline[268].

Concentrations of NO_2 have been declining on average, although London Marylebone Road (the site with the highest NO_2 levels in England) and several other sites are showing increasing concentrations in the most recent years. Long-term trend data combined with increasingly restrictive emissions legislation for road transport would be expected to lead to an improvement in air quality in the long term.

Scotland

There is an improving trend in air pollution in Scotland in recent years. For instance[269]:

- Scotland's NOx emissions have declined by 65% since 1990 and currently account for 9% of the UK total.
- Power generation is a very significant source of NOx emissions, accounting for 27% of the Scotland total in 2012.
- Scotland's PM10 emissions have declined by 59% since 1990 and account for 10% of the UK total.
- At 37%, emissions from commercial, domestic and agricultural combustion were the main source of PM10 in 2012.
- Emissions from power generation account for 25% of total emissions in 1990 but have significantly reduced to 8% in 2012. This has been primarily attributed to the move from coal fired to gas energy generation, which has negligible particulate matter emissions.

Wales

In Wales (and the rest of the UK) the most widely exceeded limit value is for the annual mean NO_2 concentration (40 µg m-3). The mean for the long-running sites shows a slight decrease through the 2000s, although 2010 was a high year. Annual mean PM_{10} concentrations have generally decreased in recent years, at both urban background and urban traffic sites. Ozone concentrations tended to be highest at rural locations, although there are no clear trends, concentrations vary considerably from year to year because of variation in metrological factors.

[267] BEIS (2017) *UK Informative Inventory Report (1990 to 2015)*. Available online at: https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1703161205_GB_IIR_2017_Final_v1.0.pdf
[268] Defra (2007). *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Volume 2*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69337/pb12670-air-quality-strategy-vol2-070712.pdf
[269] Scottish Government (2015) *Scottish Air Quality Database Annual Report 2014.* Available online at: http://www.scottishairquality.co.uk/assets/documents/technical%20reports/SAQD_annual_report_2014_Issue_1.pdf

Improvements in air quality are anticipated in the long term, mirroring trends elsewhere in the UK.

Assessing Significance

The objectives and guide questions related to air quality which have been identified for use in the appraisal of the effects of Geological Disposal Infrastructure NPS proposals are set out in **Table 7.1**, together with reasons for their selection.

Table 7.1 Approach to Assessing the Effects of the Geological Disposal Infrastructure NPS on Air

Objective/Guide Question	Reasoning
Objective: To minimise emissions of pollutant gases and particulates and enhance air quality, helping to achieve the objectives of the Air Quality and Ambient Air Quality and Cleaner Air for Europe Directives.	The SEA Directive (2001/42/EC) requires that likely significant effects on air quality be taken into account in the Environmental Report, which for the purposes of the AoS is incorporated within the AoS Report.
Will the Geological Disposal Infrastructure NPS affect air quality?	The Ambient Air Quality and Cleaner Air for Europe Directive (2008/50/EC) aims to avoid the harmful effects on human health and the environment from air pollution and includes objectives and targets for ambient air quality. This is transposed into UK law by Air Quality Standards Regulations 2010.
Will the Geological Disposal Infrastructure NPS create a nuisance for people or wildlife (for example from dust or odours)?	Emissions to air may create dust or odours that have the potential to affect air quality or to be classed as a statutory nuisance (as under Environmental Protection Act 1990).

Table 7.2 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the air quality objective.

Table 7.2 Illustrative Guidance for the Assessment of Significance for Air

Effect	Description	Illustrative Guidance
++	Significant Positive	• Option would significantly improve local air quality through a sustained reduction in concentrations of pollutants identified in national air quality objectives.
+	Positive	• Option would lead to a minor improvement in local air quality from a reduction in concentrations of pollutants identified in national air quality objectives.
0	Neutral	• Option would not affect local air quality.
-	Negative	• Option would result in a minor decrease in local air quality; • Option would have a negative effect on local communities and biodiversity due to an increase in air and odour pollution and particulate deposition.
--	Significant Negative	• Option would cause a significant decrease in local air quality (e.g. leading to an exceedance of Air Quality Objectives for designated pollutants and the designation of a new Air Quality Management Area); • Option would have a strong and sustained negative effect on local communities and biodiversity due to significant increases in air and odour pollution and particulate deposition.
?	Uncertain	• From the level of information available the effect that the option would have on this objective is uncertain.

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 7.3 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria[270]' and 'No NPS' on the air quality objective. The appraisal considers in-turn the three sub-sections used for each

[270] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

topic within Chapter 5 (Impacts) of the draft NPS: Applicant's Assessment; Decision Making and Mitigation. The performance of the draft NPS and the two reasonable alternatives are scored accordingly, with a commentary provided in the Appraisal column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15 - 20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement. These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-term (less than 20 years), MT – medium-term (between 20 and 170 years) and LT – long-term (>170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

Table 7.3 Appraisal of the Draft NPS and Reasonable Alternatives: Air Quality

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	+	+	+/?	**Draft NPS:** The text in the Draft NPS under the heading of the Applicant's Assessment (Paragraph 5.2.4) states that: "*Where the air pollution impacts of the proposed development are likely to be significant, or cumulatively could lead to a breach of Air Quality Directive thresholds, the applicant should undertake an assessment of the impacts of the proposed development as part of the Environmental Statement*". The introductory text of chapter five of the draft NPS notes that sufficient information is crucial to good decision-making, particularly where formal assessments are required, such as Environmental Impact Assessment. So to avoid delay, the draft NPS advises that applicants should discuss what information is needed with statutory environmental bodies as early as possible. The text notes that air quality considerations are likely to be particularly relevant where geological disposal infrastructure is proposed within or adjacent to Air Quality Management Areas (AQMAs) or where they may have potential impacts on Natura 2000 sites, including those outside England. Paragraph 5.2.2 also states that: "*Current UK legislation sets out health-based ambient air quality objectives. In addition, the European Union has established common, health-based and ecosystem-based ambient concentration limit values for the main pollutants in Directive (2008/50/EC) ('the Air Quality Directive'), which Member States are required to meet by various dates*". This should help to ascertain the significance of impacts upon air quality. The draft NPS also provides guidance on what the contents of an Environmental Statement (ES) should include with specific regards to air quality. The Applicant's Assessment section (Paragraph 5.2.7) concludes with information relating to national air quality projections published by Defra, how the Applicant's Assessment should be consistent with these projections (but may include detailed modelling to demonstrate local impacts). In addition to the assessment of the likely significant effects of a project in relation to the Environmental Impact Assessment, the applicant must also provide the Secretary of State with an assessment of the risk of the project with regard to the UK's ability to comply with the Air Quality Directive. The requirement for the preparation of an ES will help to ensure that effects associated with the construction and operation of GDF-related NSIPs on air quality are properly considered and appropriate mitigation measures identified. In this context, the draft NPS stipulates that the following information should be included within the ES (paragraph 5.2.6): • existing (background) air quality levels; • any significant air quality effects, associated with the development (both alone and in-combination), their mitigation and any residual effects distinguishing between the project stages, and taking account of any significant emissions from any traffic generated by the project; • contribution of air emissions to site specific critical levels and loads for the protection of vegetation and ecosystems after mitigation methods have been applied; and • contribution of air emissions to ambient air quality after mitigation methods have been applied. The requirement for significant effects on air quality to be assessed as part of the ES and mitigation measures identified should help to reduce adverse effects on air quality arising from the construction and operation of GDF-related NSIPs. Overall, this has been assessed as having a positive effect on air quality. *Recommendations for Improvement*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				It would be useful for the text to make direct reference to the Planning Practice Guidance (PPG) on the level of suggested detail to be included within an air quality assessment as part of the ES (PPG Air quality, How detailed does an air quality assessment need to be? Paragraph: 007 Reference ID: 32-007-20140306). The text in the draft NPS mentions Natura 2000 sites (paragraph 5.2.5 refers) but then does not set out the potential need for HRA and the need for air quality to be considered in the HRA, although the introduction does provide a cross reference to section 5.4 (Biodiversity and Natural Environment) of the draft NPS which at 5.4.9 references the Conservation of Habitats and Species Regulations 2016. Additionally, the text could make reference to other parts of the PPG, notably when air quality could be relevant to a planning decision (PPG Air Quality, When could air quality be relevant to a planning decision? Paragraph: 005 Reference ID: 32-005-21040306). Direct reference to PPG will also serve to substantiate links to the enhancement of air quality impacts to ensure that the Applicant's Assessment makes the most of these opportunities (which are further specified under Decision Making). Consideration should also be given to providing further guidance on the possible contents of the ES with regards to air quality. Furthermore, early pre-application engagement with, inter alia, the relevant local planning authority and the Environment Agency should identify any shortcomings within the information relating to air quality within the ES. Additionally, applicants could consider local air quality action plans and strategies, where relevant and appropriate. The existing wording contained in the NPS relating to the scope of the ES and its contents is considered to be broadly comprehensive. To further enhance the wording, the following additional requirements could be included[271]: • the legislative, regulatory and policy context for the assessment; • the evolution of the air quality baseline, without the proposed development proceeding; • the basis for determining significance of effects arising from the impacts; • details of the assessment methods; • air quality model verification; • identification of sensitive locations and receptors (whether members of the local community or Natura 2000 sites); and • summary of the assessment results including the significance of any residual (post mitigation) effects on air quality.
				Draft NPS including Exclusionary Criteria: The effects of this reasonable alternative would be similar to those identified in respect of the draft NPS above. However, the setting of clear parameters for siting which excludes specific landscape, cultural and natural heritage assets are considered likely to yield positive effects as they will help to ensure that air quality impacts associated with GDF-related NSIPs do not have adverse effects on designated nature conservation sites. However, unintended effects could be produced as a consequence, such as greater pressure on locations with existing air quality issues such as AQMAs which are not, at present, included within the exclusionary criteria. Although given existing policy and legislation on air quality and requirements of the draft NPS, this would be unlikely.

[271] Institute of Air Quality Management (2015) *Land-use Planning & Development Control: Planning for Air Quality*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				No NPS: DCO applications would be subject to the provisions of national planning policy, EIA Regulations, HRA Regulations, Environmental Permitting Regulations, Air Quality Regulations and local air quality action plans under this alternative. This would be expected to help ensure that adverse effects on air quality associated with GDF-related NSIPs are identified, assessed and appropriately mitigated. However, the absence of a clear statement on the full range of considerations to be taken into account (as proposed in the draft NPS) risks inconsistency in interpretation and unintended consequences through implementation. However, this reasonable alternative is considered to have a positive, albeit uncertain, effect against the air quality assessment objective.
Decision Making	**+**	**++**	**+/?**	**Draft NPS:** The draft NPS sets out what the Secretary of State, as decision maker, must take into account when considering the effects of GDF-related development on air quality. This should include: the consideration of AQMAs and their local air quality action plans; air quality impacts over a wider area than just that of the proposed development; and relevant air quality thresholds, including those set out in the Air Quality Standards Regulations 2010 and the Air Quality Directive (paragraphs 5.2.8 and 5.2.9 refer). As such, impacts on air quality will sought to be minimised or mitigated where appropriate, in line with domestic and European legislation. The draft NPS indicates at paragraph 5.2.12 that the Secretary of State should refuse consent for development where air quality impacts either result in areas becoming non-compliant with the Air Quality Directive or affect the ability of a non-compliant area to become compliant within an appropriate timeframe. The Secretary of State must ensure that the Environment Agency are satisfied that emissions produced during construction and operation are regulated under the environmental permitting regime. Regulation and monitoring after decommissioning and closure of the geological disposal infrastructure will be subject to the requirements of the Environment Agency. The Secretary of State is entitled to rely on appropriate regulation of impacts in considering development consent (paragraph 5.2.13 refers). Overall, the likely effects of the draft NPS are considered to be positive, with adverse impacts being minimised or mitigated where appropriate. *Recommendations for Improvement* The current text in the draft NPS does not include reference to HRA in the Air Quality section. The Secretary of State must have regard of the Conservation of Habitats and Species Regulations 2016 when considering development, where that development is likely to have a significant effect on a European sites (arising from emissions to air, and covered by the air quality topic section). It is suggested that this could be included in paragraph 5.2.11 of the draft NPS as per “or would result in likely significant effects on Natura 2000 sites”. This has linkages to paragraph 5.4.10 of the draft NPS.
				Draft NPS including Exclusionary Criteria: Setting clear exclusionary criteria for siting which specifically excludes landscape, cultural and natural heritage assets including Natura 2000 sites and SSSI would mitigate adverse impacts on air quality within these areas and help to establish clearer parameters for decision making. This would be expected to have significant positive effects on air quality in areas adjacent to and within the exclusionary criteria by introducing protection to them. However, as noted above, unintended effects could be produced as a consequence, such as the greater pressure on areas not afforded protection by the exclusionary criteria, including AQMAs, and the deterioration of areas currently assessed as being complaint with the Air Quality Directive. Although given existing policy and legislation on air quality and the requirements of the draft NPS, this would be unlikely.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				No NPS: DCO applications would be subject to the provisions of national planning policy, EIA Regulations, HRA Regulations and the Air Quality Regulations under this alternative which would be considered to have a positive, albeit uncertain, effect against the air quality assessment objective. The uncertain effects arise from the absence of a clear statement of the full range of considerations to be taken into account (as proposed in the draft NPS) risks inconsistency in interpretation and unintended consequences through implementation.
Mitigation	**+/?**	**+/?**	**+/?**	**Draft NPS:** The draft NPS (and EIA Regulations) requires the applicant, through the ES, to propose mitigation measures which the Secretary of State should be satisfied with in respect of any identified adverse air quality impacts during both construction and operational emissions. The draft NPS suggests that a construction management plan should be submitted which addresses every aspect of a GDF-related development including, inter alia, construction and environmental activities, which will help to organise mitigation measures at this stage (Paragraph 5.2.14 of the draft NPS). When considering the proposed mitigation measures, the draft NPS highlights that the Secretary of State may refer to conditions and advice in the UK Air Quality Strategy (Paragraph 5.2.15 of the draft NPS). In terms of specific mitigation measures, the draft NPS suggests that air quality impacts may be reduced or mitigated through, for example, the: consideration of location, design and layout; consideration of technologies employed; and consideration of energy use (Paragraph 5.2.16 of the draft NPS). It is expected that identified mitigation measures for, inter alia, traffic and transport impacts may help to mitigate against the effects of air emissions from transport which are not controlled by an Environmental Permit (Paragraph 5.2.17 of the draft NPS). *Recommendations for Improvement* The mitigation measures identified in the draft NPS could be revised to be more specific and clearly reflect the potential effects associated with the key project stages of site investigation, construction, operation and closure, as summarised below[272]: *Site Investigation* Adverse effects on air quality during the siting process would mainly arise as a result of vehicle movements, construction plant and generators and dust generated during the construction of drilling pads, compounds, access routes etc. The 2016 Geological Disposal Generic Environmental Assessment report prepared by Radioactive Waste Management Ltd. (the 2016 Report) considers that vehicle movements and associated emissions to air are likely to be limited in comparison to the main construction phases of the GDF. The assessment concludes that whilst any dust created could have an effect on local air quality and create minor nuisance, this could be avoided through appropriate and well-established management methods. Potential effective mitigation measures within an environmental management plan that could be set out in the draft NPS include (Appendix B Table 8 of the 2016 Report): • minimisation of emissions from on-site plant;

[272] Radioactive Waste Management Ltd (December 2016) *Geological Disposal Generic Environmental Assessment*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• minimisation of emissions from vehicles; • prevention of generation of dust; and • suppression of dust during dry weather. This topic has strong linkages with the transport topic and the mitigation measures identified including, in particular, promoting sustainable transport modes and designing access/transport routes to minimise effects of transport on sensitive receptors. *Construction* Adverse air quality effects during the construction phase principally relate to emissions to air arising from road and rail traffic to and from a site, although the 2016 Report considers that this is unlikely to lead to significant adverse effects on air quality. However, dust generated during the construction phase including, inter alia, earthworks, soil stripping, storage and use of materials on site and excavations could have an adverse effect on local air quality if unmanaged, particularly though the generation of nuisance dust. In addition to the continuation of the above mitigation measures, additional mitigation measures during construction could include the inclusion of appropriately designed ventilation systems, in accordance with best practice, to minimise emissions of pollutants. *Operation & Closure* As per the construction phase of development, identified adverse effects during the operation and closure period are based on road and rail traffic to and from a site, although the 2016 Report considers that this is unlikely to lead to significant adverse effects on air quality. Other potential adverse effects during the operation period include dust generated from the handling of excavated materials and the generation of on-site emissions of dust and fumes/gases via ventilation systems which could have an adverse effect on air quality and cause nuisance if unmanaged. Dust generated during operation could be prevented through the utilisation of established control methods whilst exhaust emissions would be subject to testing against regulatory limits so to comply with the site's environmental permit. Demolition and clearance activities during the closure phase could generate dust which may have an adverse impact on air quality and cause nuisance if unmanaged. However, such adverse effects could be mitigated through appropriate and well-established management methods. In addition to the continuation of the above mitigation measures, additional mitigation measures during operation could include (Appendix B, Table 8 of the 2016 Report): • environmental management and monitoring in relation to air quality and dust as a continuous, ongoing activity; • the periodic review and updating of the an environmental management plan; and • dust suppression measures, as required, during demolition / clearance of surface facilities.
				Draft NPS including Exclusionary Criteria: The specification of exclusionary criteria is unlikely to make a difference to the application of the mitigation measures and enhancement measures as set out for the draft NPS above, and as such the predicted effects are likely to be similar.
				No NPS: Appropriate mitigation measures will be considered by the relevant authority in light of the proposals submitted. As

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				such, mitigation measures will be forthcoming but there is the risk that they are not comprehensive or consistent (without the direction and guidance given in the draft NPS) and so will not fully address any effects arising or could be accompanied by greater uncertainty.
Other Sections of the Draft NPS Relevant to Air Quality				**1. Introduction** 1.1.3 Provision is made for the consideration of effects on local air quality in a specific locality through the requirement that a local impact report is submitted by a local authority in accordance with the Planning Act. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on air quality as an issue, helping to ensure that consideration is given to likely effects in a particular locality. 1.1.4 Consideration of the effects on air quality is reflected in the need to apply the draft NPS in the context balancing adverse impacts and benefits. The net result of this balancing exercise could be uncertain, however. 1.1.7 The generic impacts considered in the draft NPS, along with the application of the draft NPS as a material consideration on a case by case basis, could result in uncertainty over what provisions will be applied in respect of the protection of air quality impacts and the mitigation of adverse effects. **1.4 Consideration of deep boreholes investigations** – the role and content of an ES, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of air quality impacts, avoiding or reducing harm and providing appropriate mitigation measures where required. **1.5 Consideration of geological disposal facilities** – the spatial disposition of facilities and the timescale of development could affect air quality impacts although the requirements for limiting cumulative negative impacts within safety and reasonable financial constraints should help to minimise impacts. However the net long-term effects remain uncertain (although see 4.2 below). The Environment Agency will regulate the environmental aspects of the GDF including, inter alia, any discharges from the ventilation system of the facility during operation). Regulatory approval from the Environment Agency is not a prerequisite to the granting of development consent and therefore not required at the application stage, however the Secretary of State and Examining Authority may wish to seek advice on the progress of appropriate environmental authorisations. **2. Government Policy on Management of Higher Activity Radioactive Waste** 2.2.6. The preference for disposal through a single site will help to confine effects to a specific area thus limiting effects on air quality, although these would be greater in a single location. These could still be significant in respect of a particular site. 2.4.3 The strategy for implementation provides for the opportunity to consider air quality issues as the process proceeds iteratively in tandem with the siting process. **3. The Need for Geological Disposal Infrastructure** No direct relationship identified. **4. Assessment Principles** **4.1 General principles of assessment** – The scale of development proposed by a GDF could lead to significant impacts on the environment, the economy and communities. The provisions of the Planning Act and the policies and protections set out in the draft NPS provide for a balanced consideration of impacts and benefits. The requirement for the identification of positive and adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for consideration of air quality issues. This section also provides detail on the principles against which the application should be judged in relation to design, environmental, health, safety and security aspects, as noted in Table 1 of the draft NPS. **4.2 Environmental Impact Assessment**– the consideration of proposals within the EIA Regulations and the preparation of an ES (where required) agreed by statutory

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	agencies and specifying mitigation measures and enhancement measures will ensure that air quality impacts are fully considered, as will the consideration of cumulative effects and interrelationships between effects. **4.3 Habitats Regulations Assessment** – suggested that applicants refer to section 5.2 of the draft NPS on air quality, when undertaking a HRA which could be expected to reduce potential adverse effects on Natura 2000 sites related to emissions to air. **4.4 Alternatives** – the identification of reasonable alternatives that will be required as part of scheme design and project planning should ensure that air quality impacts are taken into account, both in terms of protection and opportunities for mitigation and enhancement. **4.5 Criteria for 'good design for geological disposal infrastructure** – applying 'good design' to geological disposal projects should produce sustainable infrastructure sensitive to place, efficient in the use of natural resources and energy used in their construction. A good design should meet the principal objectives of the scheme by eliminating or substantially mitigating the significant impacts, by improving operational conditions and simultaneously minimising adverse impacts. Good design, in terms of siting and use of appropriate technologies can help mitigate adverse impacts, including emissions to air. **4.6 Climate Change Adaptation** – when considering a proposal, the Secretary of State should take the effects of climate change into account. Whilst the UK Government is taking measures to mitigate the effects of climate change and reducing emissions, including reducing and mitigating against adverse effects and impacts against air quality, the Intergovernmental Panel on Climate Change (IPCC) estimate that warming will continue over the lifetime of a GDF. **4.7 Pollution Control and other Environmental Regulatory Regimes** – issues relating to discharges or emissions from a proposed project which affect, inter alia, air quality will be subject to separate regulation under the pollution control framework or other consenting or licensing regimes. Any activities within the development that are regulated under those regimes will need to obtain the relevant permissions before the activities can be undertaken. The various planning and pollution control systems will act to protect air quality impacts, particularly where these are to be considered as part of the judgement on whether the development is an acceptable use of the land, the impacts of that use, with the assumption that pollution control will be properly applied and enforced. The planning and pollution control systems are separate but complementary. Pollution control is concerned with preventing pollution through the use of measures, such as environmental permits, to prohibit or limit the release of substances to the environment from different sources, to the lowest practicable level. Environmental permits cannot control impacts from sources outside the facility's boundary such as those from traffic movements and associated emissions. **4.8 Common Law Nuisance and Statutory Nuisance** – there is a direct relationship in terms of adverse effects arising from transport which may be perceived as a nuisance. During examination, possible sources of nuisance under Section 79(1) of the Environmental Protection Act 1990 and how they may be mitigated or limited is considered by the Examining Authority. This will enable the Examining Authority to recommend appropriate requirements that the Secretary of State may wish to include in any subsequent order granting development consent. Possible sources of nuisance under the 1990 Act include, inter alia: • smoke emitted from premises so as to be prejudicial to health or a nuisance; • fumes or gases emitted from premises so as to be prejudicial to health or a nuisance; and • any dust, steam, smell or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance. **4.9 Safety** – no direct relationship identified. **4.10 Health** – noted that where the proposed development has an effect on human beings, the ES should assess these effects for each element of the project, including air quality, identifying any adverse health impacts and mitigation measures to avoid, reduce or compensate for such impacts as appropriate. **4.11 Security Considerations** – no direct relationship identified. The effects from the draft NPS and the reasonable alternatives have identified no substantive difference in effects identified against the Appraisal of Sustainability objective between reasonable alternatives.			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Summary Appraisal of Likely Significant Effects	+	++	+/?	**Draft NPS:** The development of GDF-related infrastructure can be expected to involve emissions to air which could lead to adverse impacts on human health as well as biodiversity. Sources of potential emissions to air include emissions from vehicle movements, construction plant, generator and dust generated during construction. Air quality standards and objectives are governed by European and domestic legislation. Where impacts of a project are expected to affect the UK's ability to meet the targets laid out in legislation, or result in significant negative effects on air quality in accordance with the EIA Regulations, the draft NPS sets out that the applicant must undertake an assessment of the impacts as part of the ES. The Secretary of State, as decision maker, must consider air quality impacts over an area wider than that of the development site and work with the applicant and relevant authorities to secure appropriate mitigation measures where a project is likely to lead to a breach of air quality thresholds. The Secretary of State must ensure that mitigation measures are satisfactory and can refuse consent where there are significant impacts on air quality which would contravene the Air Quality Directive. Overall, the draft NPS aims to protect air quality objectives, as any proposal which would result in a compliant zone or agglomeration with the Air Quality Directive becoming non-compliant or affect the ability of a non-compliant area to achieve compliance within the most recent timescales reported to the European Commission, after taking mitigation measures into account, would be refused consent by the Secretary of State. The draft NPS requires the Examining Authority to consider possible sources of nuisance, including smoke, fumes or gases, and how they may be mitigated or limited so as not to adversely affect air quality. Application of the draft NPS is therefore likely to result in positive effects in respect of minimising emissions of pollutant gases and particulates and enhancing air quality.
				Draft NPS including Exclusionary Criteria: Positive effects on air quality associated with this reasonable alternative are expected to be broadly similar to those identified in respect of the draft NPS above. However, the magnitude of positive effects will be potentially greater. This reflects the potential for the setting of clear parameters for siting which excludes specific landscape, cultural and natural heritage assets to help to avoid adverse air quality-related impacts on nature conservation sites.
				No NPS: Despite the absence of a guiding framework for air quality impacts, this reasonable alternative is likely to result in positive effects overall, albeit somewhat uncertain, as any development would be subject to the provisions of, inter alia national planning policy EIA Regulations, HRA Regulations and Air Quality Regulations. However, the absence of a clear statement on the full range of considerations to be taken into account risks inconsistency in interpretation and unintended consequences through implementation. Additionally, without a clear statement on the role of the Secretary of State, development may not effectively mitigate adverse impacts with regards to air quality. It is acknowledged that whilst mitigation measures would be forthcoming in this alternative, they may not fully address an appropriate range of activities.
Summary of Recommending Mitigation and Enhancement	Although the draft NPS is considered to have a positive effect in terms of minimising emissions of pollutant gases and particulates from GDF-related activities and enhancing air quality, the appraisal identifies a number of recommended mitigation measures and enhancement measures that could be applied. It is suggested that the draft NPS makes direct reference to Planning Policy Guidance, with regards to air quality, and makes suggestions and provides further guidance on the contents of the Environmental Statement. Identified mitigation measures in the draft NPS could be revised to be more specific and clearly reflect the potential effects associated with the key project stages including the use of well-established management methods, environmental management plan, control methods and testing and monitoring against relevant and regulatory limits. Consideration could also be given to encouraging early engagement between the applicant and the Environment Agency and relevant local authority and the consideration of local air quality action plans and strategies. Finally, there may be scope in this section to provide cross-reference to requirements under the Habitats			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	Directive.			

8. Noise

Introduction

This section presents the overview of plans, programmes, and baseline information and the detailed appraisal of sustainability of the National Policy Statement for Geological Disposal Infrastructure and reasonable alternatives in respect of noise.

Noise in an environmental context is defined as unwanted sound. Emissions of noise may arise during construction, operation and decommissioning of development and could affect human and ecological receptors.

There are links between the noise topic and other topics in the Appraisal of Sustainability (AoS), specifically human health, biodiversity and nature conservation and landscape.

Review of Plans and Programmes

The policies seek to manage both ambient noise and noise emitting from a particular point source. The policies provide the framework to manage potentially high levels of noise during the construction phase of the geological disposal infrastructure, both on site and noise associated with transport movements, as well as the operation and eventual decommissioning (although these later stages are anticipated to be less likely to be associated with high levels of noise).

International

The World Health Organisation's (WHO) ***Guidelines for Community Noise 1999*** notes that in comparison to many other environmental problems, noise pollution levels continue to increase rather than reduce, coupled with an increasing number of complaints from affected individuals. The document states that 'Noise is likely to continue as a major issue well into the next century'. WHO research has identified noise exposure levels within the population that are considered to have harmful effects on human health. Based on this research, the WHO has developed a number of recommended noise levels that should prevent adverse health effects. This document is widely referenced in the field of acoustics. However, it has not been adopted into any subsequent guidelines or UK regulation. The WHO's ***Night Noise Guidelines for Europe (2009***), meanwhile, seeks to avoid health impacts from exposure to noise during sleep.

The ***Environmental Noise Directive (END) (2002/49/EC)*** is concerned with noise from road, rail, air traffic and industry. The level of exposure to environmental noise has been determined through noise mapping to which it has been proposed will give rise to noise action plans. The four sets of ***Environmental Noise Regulations 2006*** (SI 2006/2238 in England; WSI 2006/2629 in Wales; SSI 2006/465 in Scotland; and NSIR 2006/387 in Northern Ireland), address the requirements of END to inform the production of noise action plans for large urban areas (END agglomerations), major transport sources, and significant industrial sites. The action plans are intended to manage noise issues and effects to ensure the noise environment is preserved or noise levels are reduced where possible. The first noise maps were completed in 2007 and updated in 2012.

UK

The ***Environmental Protection Act (1990)*** defines the legal framework with England, Scotland and Wales for duty of care for waste, contaminated land and statutory nuisance (including noise emitted from Premises be prejudicial to health or a nuisance). Further provisions with respect to noise (as well as waste disposal, water pollution, atmospheric pollution and public health) are set out in the ***Control of Pollution Act 1974.*** Noise, litter and waste controls are introduced in the ***Clean Neighbourhoods and Environment Act 2005.***

The ***Control of Noise at Work Regulations 2005 (the Noise Regulations)*** (SI 2005/1643) aims to ensure that workers' hearing is protected from excessive noise at their place of work, which could cause them to lose their hearing and/or to suffer from tinnitus.

The Institute of Environmental Management and Assessment (IEMA) / Institute of Acoustics (IoA) document ***Updated Guidelines for Noise Impact Assessment*** were published in October 2014. The guidelines are applicable to noise impact assessment for any scale of development proposal.

The British Standards Institution (BSI) document ***BS 8233: 2014 - Sound Insulation and Noise Reduction for Buildings – Code of Practice*** gives recommendations for the control of noise in and around buildings, and suggests appropriate criteria and limits for different situations. The code is primarily intended to guide the design of new or refurbished buildings, but it does provide a source of noise levels for common situations, such as typical traffic noise levels at the facades of buildings.

The BSI document ***BS 5228-1: 2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites*** gives recommendations for basic methods of noise control relating to construction and open sites where work/activities generate significant noise levels. Part 1 provides guidance concerning methods of predicting and measuring noise and assessing its effects. Part 2 provides guidance concerning methods of predicting and measuring vibration and assessing its effects.

England

The ***National Planning Policy Framework (Department for Communities and Local Government, 2012)*** (NPPF) sets out the core land use planning principles that should underpin both plan-making and decision taking. The Framework expects the planning system to prevent “both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of [inter alia] noise pollution”.

In addition, paragraph 123 of the NPPF provides that planning policies and decisions should aim to: avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development; mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions; recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason. The noise section of the ***Planning Practice Guidance*** provides advice regarding the consideration of potential noise impacts in planning decisions.

Noise Policy Statement for England (Defra, 2010) sets out the long-term vision of Government noise policy which seeks to promote good health and quality of life through the

effective management of noise within the framework of Government policy on sustainable development.

In accordance with the Environmental Noise (England) Regulations 2006, Defra has prepared a Noise Action Plan, designed to address the management of noise issues and effects from roads and railways in the 65 agglomeration areas in England. The Action Plan is underpinned by the results of a second strategic mapping exercise.

Scotland

The ***Environmental Noise (Scotland) Regulations 2006*** (SSI 2006/465) requires that Scottish ministers must prepare Strategic Noise Maps and Noise Action Plans which identify Quiet Areas and areas where management of noise is required. The Scottish Government identifies such areas as Noise Management Areas (NMAs).

In accordance with the Regulations, action plans have been prepared (and in some cases prepared and subsequently updated) for:

- Edinburgh Agglomeration;
- Glasgow Agglomeration;
- Dundee Agglomeration;
- Aberdeen Agglomeration;
- Transportation;
- Aberdeen Airport;
- Edinburgh Airport; and
- Glasgow Airport.

The ***Scottish Planning Policy (SPP) (2014)*** stresses the role of noise impact assessments in developments where noise is likely to be considerable, and emphasises the need for mitigation where noise is likely to require some form of control.

Planning Advice Note 1/2011 (PAN) Planning and Noise (2011) provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise.

Wales

The ***Wales Spatial Plan Update (2008)*** recognises the work of multiple organisations in helping to promote shared learning and the development a medium-term strategy for the sustainable development of Wales. The Update is in keeping with the One Wales, One Planet principles in 2008 and provides the context and direction of travel for local development plans and the work of local service boards. The key themes of the update are:

- building sustainable communities;
- promoting a sustainable economy;
- valuing our environment;
- achieving sustainable accessibility; and
- respecting distinctiveness.

Planning Policy Wales (9th: Chapter 13 – Minimising and Managing Environmental Risks and Pollution (2016) sets the Welsh Government's objectives to maximise environmental protection for people, prevent or manage pollution and promote good environmental practice.

Technical Advice Note (TAN) 11: Noise (1997) sets out the Welsh Government's land use planning policy in respect of noise generating development, noise-sensitive development and measures to mitigate the impact of noise. It sets out that local planning authorities must ensure that noise generating development does not cause an unacceptable degree of disturbance. They should also bear in mind that if subsequent intensification or change of use results in greater intrusion, consideration should be given to the use of appropriate conditions.

Overview of the Baseline

UK

Noise and vibration are predominantly local in nature and difficult to measure on a regional or national scale. ***The National Noise Attitude Survey 2012 – NO0237 (December 2014)***[273] was undertaken to:

- provide the Government with a good estimate of current attitudes to various aspects of environmental, neighbour and neighbourhood noise (including the percentage of the population affected); and
- allow the Government to detect any substantive changes in attitudes to noise in the UK since the 2000 survey.

A summary of findings revealed that 72% of respondents reported general satisfaction with their noise environment. However, between 2000 and 2012 there was an increase of between 11% and 17% (depending on the noise source) in the proportion of people surveyed who felt that they were to some extent adversely affected by the four most commonly heard sources of noise ('road traffic', 'neighbours and/or other people nearby', 'aircraft, airports and airfields' and 'building, construction, demolition, renovation and road works'). Also in the same period there was a decrease of between 10% and 16% (depending on the noise source) in the proportion of people surveyed who felt that they were not at all adversely affected by the four most commonly heard sources of noise.

The survey also found that the proportion of those reporting themselves as being significantly adversely affected by noise had remained broadly the same since 2000, i.e. the proportion of those experiencing potentially significant adverse effects had not worsened. The number reporting hearing the four most commonly heard sources of noise had also remained broadly the same. In general, 48% of respondents said that their home life was spoilt to some extent by noise, with 52% reporting that noise did "not at all" spoil their home life.

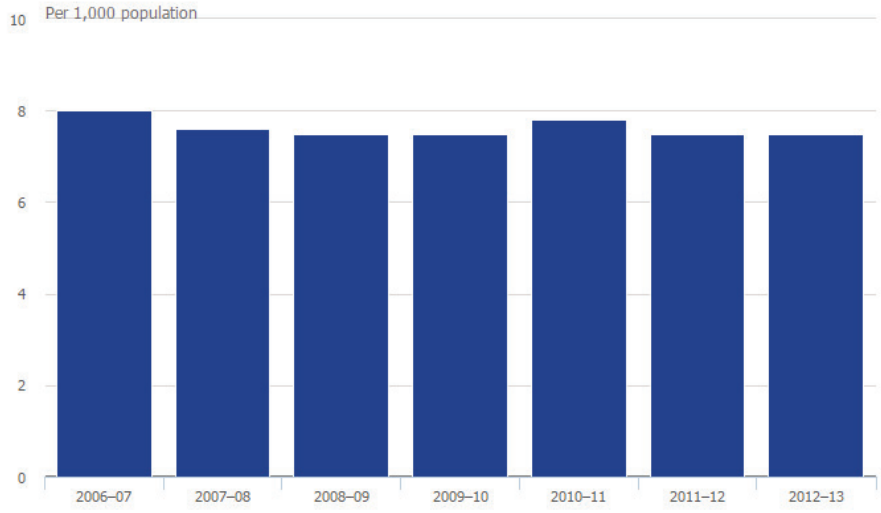
England

Figure 8.1 below shows the proportion of people making noise complaints in England, as reported within the last published edition of the ***Office for National Statistics Sustainable***

[273] Defra (2014) *The National Noise Attitude Survey 2012 – NO0237*. Available online at: http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18288

Development Indicators publication[274] (note that this is no longer published, but data for the indicators is still available from its original source).

Figure 8.1 Noise complaints per 1,000 population



Source: Office for National Statistics.

Under the terms of the END, Defra has prepared a Noise Action Plan; underpinned by the results of a strategic mapping exercise[275]. They indicate that road traffic is the most dominant noise exposure source.

The estimated number of people in agglomerations above noise level **L_{den}** due to noise from roads is shown in **Table 8.1**.

Table 8.1 Estimated number of people in agglomerations above various noise levels due to noise from roads, L_{den}

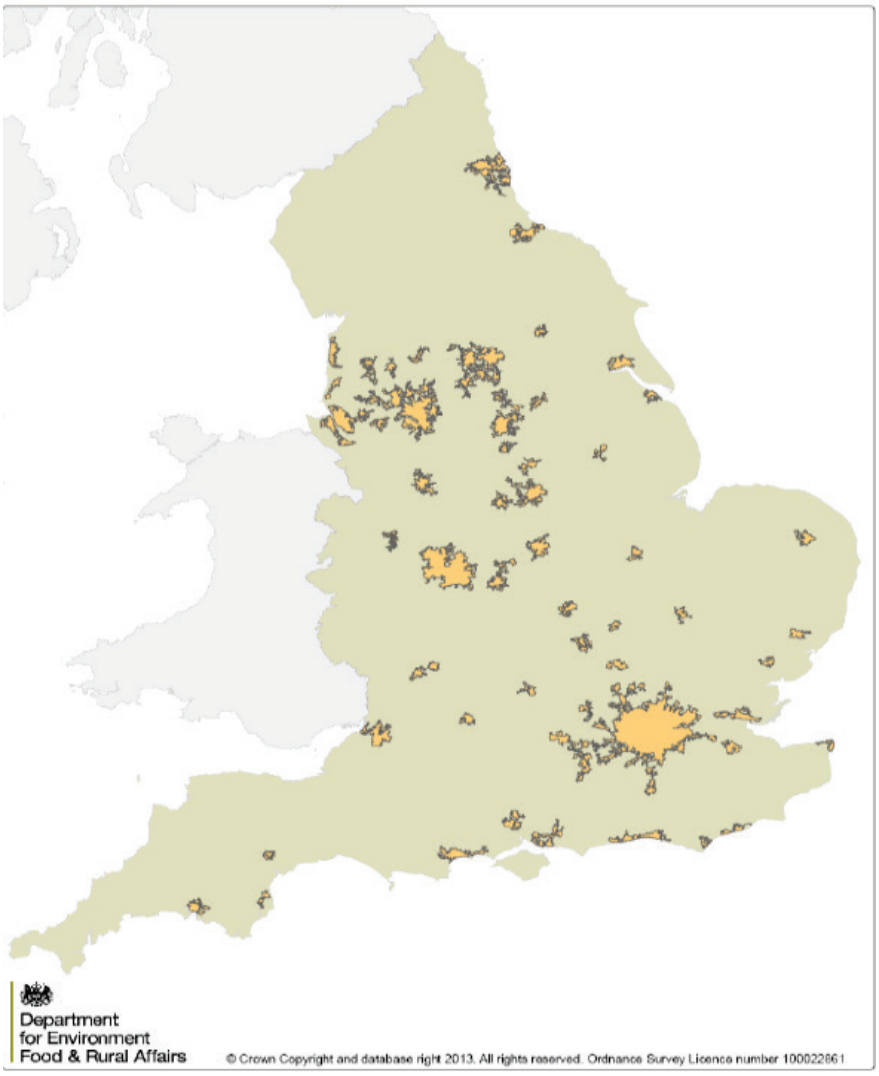
Noise Level (L_{den}) (dB)	Number of People
≥55	7,401,000
≥60	3,717,000
≥65	2,325,000
≥70	1,122,000
≥75	135,000

Defra has identified a number of “Important Areas” or “noise hotspots” through strategic mapping. It has been estimated that the number of people immediately associated with the Important Areas identified for roads inside agglomerations is just over 119,000.

[274] Office for National Statistics (2015) *Sustainable Development Indicators - Figure 20.1: Noise complaints per 1,000 population, 2006-07 to 2012-13*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/articles/sustainabledevelopmentindicators/2015-07-13

[275] Extrium (2017) *England noise map viewer*. Available online at: http://www.extrium.co.uk/noiseviewer.html

Figure 8.2 Map showing the approximate location of END agglomerations



Scotland

Interactive noise maps can be generated from the Scottish Government's Scottish Noise Mapping facility[276]. They indicate that road traffic is the most dominant noise exposure source.

Agglomerations have been mapped for the urban areas of Edinburgh, Glasgow, Aberdeen and Dundee. The number of people exposed to noise levels above L_{den} is 991,200.

Wales

Interactive noise maps showing estimated levels of road traffic, railway and industrial noise in Wales' three largest urban areas, and noise from the busiest roads and railways across Wales are available via the Welsh Government's website[277]. Based on these maps a total of 220 priority areas for road noise and 27 for railway noise have been identified[278].

[276] Scottish Government (2017) *Welcome to Scotland's noise.* Available online at: http://www.scottishnoisemapping.org/
[277] Welsh Government (2017) *Wales Noise Mapping.* Available online at: http://data.wales.gov.uk/apps/noise/
[278] Welsh Government (2014) *Noise areas*. Available online at: http://gov.wales/topics/environmentcountryside/epq/noiseandnuisance/environmentalnoise/noisemonitoringmapping/priority-areas/?lang=en

Summary of Existing Problems Relevant to the Geological Disposal NPS

The following existing problems for noise have been identified:

- Ambient noise levels are gradually rising in the UK as a result of an increasing - and increasingly mobile - population. The cumulative impacts of noise on sensitive groups in local communities may create or exacerbate existing health issues.
- Road traffic is a dominant source of noise.
- There is a need to address noise issues in the UK's most affected communities.
- Noise from the construction of a geological disposal facility will need to be assessed and where possible reduced or mitigated through guidance in the NPS.

Likely Evolution of the Baseline

It is difficult to quantify the likely evolution of noise in UK (and for England, Scotland and Wales) although it seems likely that new development will result in increases in noise levels and could thereby negatively affect people's health and the environment (e.g. disturbance to biodiversity, decreased enjoyment of the countryside). However, the Environmental Noise Regulations and associated action plans may result in the reduction of noise in priority areas over time.

The most recent trend data in **Figure 8.1** would suggest that levels of noise complaints have remained stable for the most recent 10 years' worth of data.

It needs to be recognised that as the effects of noise are felt at the local level, it is possible that even if noise levels in the UK as a whole increase or decrease, there is the potential that at the local level noise could improve or get worse as a result of an individual development (for example, if a quieter process replaces existing development). The noise from transport could also decline in the future due to quieter technology being employed in cars, buses and aeroplanes, although if the overall volume of traffic increases this could result in increased noise levels.

Assessing Significance

The objectives and guide questions related to noise (and vibration) which have been identified for use in the appraisal of the effects of the Geological Disposal Infrastructure NPS are set out in **Table 8.2**, together with reasons for their selection.

Table 8.2 Approach to Assessing the Effects of the Geological Disposal Infrastructure NPS on Noise

Objective/Guide Question	Reasoning
Objective: To minimise noise pollution and the effects of vibration.	EU and UK policy on noise management and reduction guides the preparation of strategies at the UK and local levels to avoid and limit what is a pollutant. The construction of a geological disposal facility is likely to have noise impacts associated with vehicle movements and the operation of plant and machinery. As such, the issues are important to the AoS Report in respect of human health, in particular.

Objective/Guide Question	Reasoning
Will the Geological Disposal Infrastructure NPS help to minimise noise and vibration effects from construction and operational activities on residential amenity and effects on sensitive locations and receptors?	The impacts of noise pollution and from vibration on specific localities will need careful consideration in all phases of any project associated with the development of a GDF. This could include local strategies based on general principles and practical measures for noise and vibration avoidance and limitation.

Table 8.3 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the noise objective.

Table 8.3 Illustrative Guidance for the Assessment of Significance for Noise

Effect	Description	Illustrative Guidance
++	Significant Positive	• Option would significantly improve the ambient noise environment in the vicinity of potential or actual sites.
+	Positive	• Option would lead to an improvement in the ambient noise environment in the vicinity of potential or actual sites.
0	Neutral	• Option would not affect the noise environment of potential or actual sites.
-	Negative	• Option would result in a minor negative effect on the ambient noise environment in the vicinity of potential or actual sites; • Option would cause minor disturbance associated with vibration on potential or actual sites.
--	Significant Negative	• Option would result in a major negative effect on the ambient noise environment in the vicinity of potential or actual sites over the short or longer term; • Option would cause major disturbance associated with vibration on potential or actual sites over the short or longer term.
?	Uncertain	• From the level of information available the effect that the option would have on this objective is uncertain.

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 8.4 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria[279]' and 'No NPS' on the noise objective. The appraisal considers in-turn the three sub-sections used for each topic within Chapter 5 (Impacts) of the draft NPS: Applicant's Assessment; Decision Making and Mitigation. The performance of the draft NPS and the two reasonable alternatives are scored

[279] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

accordingly, with a commentary provided in the Appraisal column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15 - 20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement. These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-term (less than 20 years), MT – medium-term (between 20 and 170 years) and LT – long-term (>170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

Table 8.4 Appraisal of the Draft NPS and Reasonable Alternatives: Noise

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	+	++	+/?	**Draft NPS:** The text in the draft NPS under the heading of the Applicant's Assessment (Section 5.3.4) states that "*Where noise impacts are likely to arise from geological disposal infrastructure, the applicant should include a noise assessment as part of the Environmental Statement (see Section 4.2). That noise assessment should include:* • *a description of the noise generating aspects of the development proposal leading to noise impacts, including the identification of any distinctive tonal, impulsive or low frequency characteristics of the noise;* • *identification of noise sensitive premises and noise sensitive areas that may be affected;* • *the characteristics of the existing noise environment;* • *a prediction of how the noise environment will change with the proposed development:* o *in the shorter term, such as during the construction period;* o *in the longer term, during the operating life of the infrastructure, and post closure; and* o *at particular times of the day, evening and night as appropriate;* • *an assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas;* • *if likely to cause disturbance, an assessment of the effect of underwater or subterranean noise; and* • *measures to be employed in mitigating the effects of noise. Applicants should consider using best available techniques to reduce noise impacts."* Alongside guidance on the scope of an Environmental Statement (ES), the draft NPS also sets out that the nature and extent of the noise assessment should be proportionate to the likely noise impact (paragraph 5.3.5). Similarly, the potential noise impact of ancillary activities associated with the development, such as increased road and rail traffic movements or other forms of transportation, should also be considered, as appropriate (paragraph 5.3.6). The text draws attention to how, with respect to human receptors, operational noise and the prediction, assessment and management of construction noise should be assessed using references to the relevant British Standards and other guidance (which also give examples of mitigation measures). The draft NPS advises that the applicant consults the Environment Agency on the likely scope of an Environmental Statement and Natural England with regard to the assessment of noise aspects on protected species or other wildlife. The results of any noise surveys and predictions undertaken may inform any ecological assessment. The seasonality of potentially affected species in nearby sites may also need to be taken into account. The requirement for the preparation of an ES with regards to noise assessment will help to ensure that effects associated with the construction and operation of GDF-related NSIPs, including ancillary activities, are properly considered and appropriate mitigation measures are identified. Overall, it is considered that there are likely to be positive effects on noise. *Recommendations for Improvement* Whilst it is acknowledged that Paragraph 5.3.9 of the draft NPS references Planning Practice Guidance (PPG) on Noise, it would be useful if the text made direct reference to the PPG on what factors influence whether noise could be a concern

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				(PPG Noise, Paragraph: 006 Reference ID:30-006-20151224). The draft NPS could also make explicit reference to the need to consider the impact on tranquillity (consistent with PPG Noise, Paragraph 0012 Reference ID 30-012-20140306). Direct reference to the PPG will also serve to substantiate links to the mitigation of the residual impacts of development related to noise so to ensure that the Applicant's Assessment makes the most of these opportunities (which are noted under Decision Making). The text in the draft NPS could also reference the World Health Organisation (WHO) standards on noise 'Guidelines for community noise' or the EU Environmental Noise Directive (2002/49/EC). As part of the ES, the noise assessment could include an estimate, by type and quantity, of expected noise resulting from the operation of the proposed development. It should also include, inter alia, a description of the measures envisaged to prevent, reduce and, where possible, offset any significant adverse effects. Consideration should also be given to providing further guidance on the possible contents of the ES with regards to noise. In addition to the information already outlined, the specification of the contents of the ES could be extended to include the following[280]: • Ensure that the identification of noise sensitive premises and noise sensitive areas outlined in the guidance includes the identification of key receptors (such as those parts of the community that could be particularly affected and/or disrupted by noise and those European and nationally designated nature conservation sites); • With reference to the guidance identified, outline what constitutes a significant impact with regard to noise; • With reference to the characteristics of the development and the receiving environment, include: o map showing site and surrounding area including receptors; and o site plan with installation boundary. • If BS4142 assessment carried out provide full noise survey report (see BS4142 'Information to be reported'); and • An indication of whether post mitigation, there are any residual effects that would still be considered significant.
				Draft NPS including Exclusionary Criteria: The effects of this reasonable alternative would be similar to those identified in respect of the draft NPS above. However, the setting of clear parameters for siting which excludes specific landscape, cultural and natural heritage assets is likely to yield significant positive effects by introducing protection to communities, species or other wildlife, considered nationally important, where tranquillity and low levels of noise intrusion are an important feature of their setting and functioning. However, unintended effects could be produced as a consequence, such as greater pressure on areas peripheral to the excluded areas and/or local assets not given specific protection, including places of tranquillity and areas of recreational value.
				No NPS: Whilst applications would be subject to the provisions of national planning policy, EIA regulations, WHO guidance (e.g. Guidelines for Community Noise 1999) and relevant British Standards (e.g. BS 5228-1: 2009 Code of Practice for Noise

[280] Environment Agency (2015) Noise Impact Assessment – information requirements

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				and Vibration Control on Construction and Open Sites +A1:2014) under this reasonable alternative, the absence of a clear statement on the full range of information to be submitted with regards to noise in the ES (as proposed in the draft NPS) risks development not effectively identifying and mitigating noise aspects. However, this reasonable alternative would still be considered to have a positive effect, albeit uncertain, against the noise assessment objective.
Decision Making	+	++	+/?	**Draft NPS:** It is expected that GDF-related development will be undertaken in accordance with the relevant statutory requirements for noise. Due regard should be given to the relevant sections of the Noise Policy Statement for England, the NPPF and the Government's associated planning guidance on noise. The draft NPS expects development to demonstrate good design through, for example, the selection of the quietest cost-effective approach available. Within the context of Government policy on sustainable development, the Secretary of State, as decision maker, should not grant consent unless satisfied that the proposal will: avoid significant adverse impacts on health and quality of life from noise from the proposed development; mitigate and minimise adverse impacts on health and quality of life from noise from the proposed development; and where possible, contribute to the improvement of health and quality of life through effective management and control of noise (paragraph 5.3.11). When determining applications, the Secretary of State should consider whether mitigation measures are needed both for construction noise and operational noise, over and above any which may form part of the development consent application. The Secretary of State may wish to impose requirements to ensure delivery of all mitigation measures. This is to ensure that the noise levels from development do not exceed those described in the assessment or any other estimates on which the decision was based (paragraph 5.3.12). For those processes in a development whose noise aspects would be subject to an environmental permitting regime, the Secretary of State may assume that the regime will exercise the necessary controls. However, the Secretary of State must take into account the potential impact from all noise sources when deciding whether or not to grant development consent and, if so, on what terms (paragraph 5.3.14). On balance, sufficient information is provided in the draft NPS to enable the Secretary of State to make an informed decision and have sufficient confidence that any adverse effects arising from noise from the proposed development will be adequately minimised and/or mitigated.
				Draft NPS including Exclusionary Criteria: Setting clear exclusionary criteria for siting which specifically excludes landscape, cultural and natural heritage assets would mitigate adverse impacts on noise within these areas and help to establish clearer parameters for decision making. This would be expected to have significant positive effects on noise in areas adjacent to and within the exclusionary criteria by introducing protection to them. However, as noted above, unintended effects could become apparent as a consequence, such as noise produced from development and ancillary activities having an adverse impact on areas peripheral to the specified areas and/or local assets not given specific protection, including places of tranquillity and areas of recreational value. However this reasonable alternative would minimise the direct effects of noise on the exclusionary criteria.
				No NPS: Under this reasonable alternative, DCO applications will be subject to the provisions of national planning policy, EIA regulations, WHO guidelines for community noise and relevant British Standards which would be considered to have a positive, albeit uncertain, effect against the noise objective. The uncertain effects arise from the absence of a clear statement on the role of the Secretary of State in seeking to ensure that development avoids, mitigates and minimises adverse impacts and improves health and the quality of life (as proposed in the draft NPS).

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Mitigation	**+/?**	**+/?**	**+/?**	**Draft NPS:** The draft NPS sets out that consideration must be given, by the Secretary of State, as to whether mitigation measures are needed for both construction and operational noise, over and above any which may form part of the project application (Paragraph 5.3.12). Requirements may be imposed so as to ensure delivery of mitigation measures where appropriate (Paragraph 5.3.12). It is expected that applicants should propose appropriate mitigation measures to limit the impact of any noise-related emissions on amenity (Paragraph 5.3.13). Paragraph 5.3.15 sets out examples of mitigation measures relating to engineering, materials, layout and administration, e.g. times of use for public announcement systems. The draft NPS stipulates that in certain situations, and only when other forms of noise mitigation have been exhausted, the applicant may consider it appropriate to provide noise mitigation through improved sound insulation (to dwellings) or, in extreme cases, through compulsory acquisition of affected properties (Paragraph 5.3.16). This is in order to gain consent for what might otherwise be unacceptable development. Where mitigation is proposed to be dealt with through compulsory acquisition, such properties would have to be included within the application in relation to which such powers were being sought. *Recommendations for Improvement* The mitigation measures identified in the draft NPS could be revised to be more specific and clearly reflect the potential effects associated with the key project stages of site investigation, construction, operation and closure, as summarised below[281]: *Site Investigation* Adverse effects on noise during the siting process would be expected to mainly arise as a result of the operation of generators and drilling activities as well as seismic and aerial surveys. Seismic and aerial surveys could generate noise and vibrations due to, for example, the use of localised explosives, vibroseis trucks and aircraft[282], but would likely be of low amplitude or short (transient) duration and therefore the effect would probably be negligible. The 2016 Geological Disposal Generic Environmental Assessment report notes (Appendix B, Table 10) that effects from borehole survey works would include perceptible increases in noise and vibration, particularly from drilling rigs (continuous and intermittent noise), diesel generators (if applicable) and works traffic (HGVs etc.). Generators and drilling activities associated with site investigation works are likely to generate some noise and, potentially, vibration. However, road traffic levels are expected to be too low to contribute significantly to noise. If sensitive receptors (e.g. occupants of residential buildings, community and recreational facilities) are present in proximity to the works then they may be affected, although noise effects are more likely than vibration effects. Nonetheless, the number and sensitivity of receptors affected (and the magnitude of effects) cannot be predicted at this stage. Mitigation measures could involve: • Full consideration of noise and vibration issues in the siting process;

[281] Radioactive Waste Management Ltd. (December October, 2016) *Geological Disposal Generic Environmental Assessment*
[282] Vibroseis is a common method of seismic survey.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• Best practice measures to limit noise levels, expressed through an environmental management plan; • Noisiest activities to be limited to certain times of day and weekdays only, where possible; • Assuming that noise sensitive receptors lie within 1 km or so of the borehole drilling locations, noise and, if necessary, vibration and air overpressure limits will be agreed with the consenting body *Construction (and underground based investigation)* During the construction stage it is considered that perceptible increases in noise could arise from both continuous and intermittent sources including: excavation and piling works; earth moving equipment, construction plant, diesel generators; construction vehicles (HGVs, concrete trucks, forklift trucks, delivery vehicles, vans and personnel vehicles); freight trains (once a rail link is in operation); and ventilation, power and access systems for the underground workings. The 2016 Geological Disposal Generic Environmental Assessment report considers that calculated levels of road traffic (staff and HGV vehicles) would be too low to contribute significantly to noise levels. The greatest source of noise from the construction stage would be from surface construction and shallow excavations, reducing as the depth of excavation increases. Airborne vibration is considered unlikely to be an issue unless properties are located within 40m of the source, and most potential sources are unlikely to be within 40m of the source. Similarly, ground-borne vibration is only likely to affect receptors in close proximity to the source, and most sources will be located well within the site. Dependent on the proximity to the site, noise associated with construction may have an effect on sensitive receptors (including occupants of residential buildings, community and recreational facilities, noise sensitive businesses and enterprises and nature conservation sites). However, the need to adhere to the requirements of legislation should reduce this. Due to the lack of spatial specificity in the draft NPS, the magnitude of potential for adverse noise effects are uncertain at this stage and would depend on the proximity of the site and works to sensitive receptors, level and extent of noise and vibration generated and ground conditions. It should be noted that bunds formed of soils and other materials stripped from the surface site and of excavated rock from the underground working would form a significant barrier to noise and would reduce adverse effects on any nearby residential properties. Should potential noise effects be an issue at the GDF site, the design and placement of these bunds would be a significant means of reducing those effects. In addition to the continuation of the mitigation measures identified during the site investigation stage, where appropriate additional mitigation measures at the construction stage should include: • construction-period environmental management plan; • detailed design of surface facilities to minimise noise of both construction and future operational activities through, inter alia, the: o choice of plant; o layout and design of facilities; o enclosing noisy plant or activities;

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				o incorporation of noise barriers/baffles at sources of noise; and o incorporation, where appropriate, of noise barriers (bunds or vertical barriers) into the detailed design of the site, potentially as part of landscape works. • Incorporate noise barriers (mounds or vertical barriers) into the detailed design of the site, potentially as part of landscape works; • assuming that noise sensitive receptors lie within 1km or so of the GDF site, noise and, if necessary, vibration and over pressure limits would be agreed with the consenting body. *Operation* During the operational stage, it is expected that sources of noise would include the: delivery of radioactive waste for disposal in a GDF; delivery of backfill material; removal and surface handling of excavated rock spoil from ongoing underground excavations and management of surface mounds; and ventilation, power and access systems for the underground workings. As per the construction stage, the 2016 Geological Disposal Generic Environmental Assessment report considers that the calculated levels of road traffic are considered to be too low to contribute significantly to noise levels. As noted previously, dependent on proximity there is potential for negative effects on sensitive receptors. Overall, noise levels are considered likely to be lower than during the construction phase although this is predicated on the utilisation of mounds as noted previously. Given that no site has been selected, the potential for adverse effects will still depend on the proximity of the site and works to sensitive receptors, ground conditions and the level and extent of noise generated. It is considered that vibration is unlikely to be a significant issue during operation. In addition to the continuation of the mitigation measures identified during the site investigation and construction stages, where appropriate, additional mitigation measures at the operation stage could include: • any required screening etc. should already be in place by the start of the operational period. Maintenance will be an ongoing activity; • ongoing noise monitoring to ensure that defined targets are not exceeded and remedial measures implemented if they are; and • monitoring of other development proposals to comment on planning applications etc. if they are sufficiently close that complaints about noise may arise. *Closure* During the closure stage, it is expected that sources of noise would include the: delivery of backfill material (by freight trains, HGVs or a combination of both); and decommissioning and demolition activities relating to the removal of surface facilities. The 2016 Geological Disposal Generic Environmental Assessment report considers that these sources of noise would not be significant. As per the previous stages, calculated levels of road traffic are not expected to significantly contribute to noise levels. Effects on sensitive receptors are not likely to be significant and would also be less than that of the previous stages although as no site has been selected, the potential for adverse effects will depend on the proximity of the site and works to sensitive receptors and the level and extent of noise and vibration generated. In addition to the continuation of the mitigation measures identified during the site investigation, construction and operation stages, where appropriate additional mitigation measures at the closure stage should be adopted as required.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Draft NPS including Exclusionary Criteria: The specification of exclusionary criteria is unlikely to make a difference to the application of the mitigation measures and enhancement measures as set out for the draft NPS above. In consequence, the predicted effects are likely to be similar with regards to noise.
				No NPS: Appropriate mitigation measures will be considered by the relevant authority in light of the proposals submitted. As such, mitigation measures will be forthcoming but there is the risk that they will not be comprehensive or consistent (without the direction and guidance given in the draft NPS) and so will not fully address any effects arising or is accompanied by greater uncertainty.
Other Sections of the Draft NPS Relevant to Noise	**1. Introduction** 1.1.3 Provision is made for the consideration of effects of DCO obligations and their impact on the local authority's area in a specific locality through the requirement that a local impact report submitted by a local authority in accordance with the Planning Act. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on noise as an issue, helping to ensure that consideration is given to likely effects in a particular locality. 1.1.4 Consideration of the effects on noise is reflected in the need to apply the draft NPS in the context balancing adverse impacts and benefits. The net result of this balancing exercise could be uncertain, however. 1.1.7 The generic impacts considered in the draft NPS, along with the application of the draft NPS as a material consideration on a case by case basis, could result in uncertainty over what provisions will be applied in respect of the consideration of noise and the mitigation of adverse effects. **1.4 Consideration of deep boreholes investigations** – the role and content of an ES, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of noise aspects, avoiding or reducing harm and providing appropriate mitigation measures where required. **1.5 Consideration of geological disposal facilities** - No direct relationship identified. **2. Government Policy on Management of Higher Activity Radioactive Waste** 2.2.6. The preference for disposal through a single site will mean that noise aspects could potentially be greater in a single location. These could be significant in respect of a particular site. 2.4.3 The technical strategy for implementation provides for the opportunity to consider noise issues as the process proceeds iteratively in tandem with the siting process. **3. The Need for Geological Disposal Infrastructure –** No direct relationship identified. **4. Assessment Principles** **4.1 General principles of assessment** – the scale of development proposed by a GDF could lead to significant impacts on the environment, the economy and communities. The provisions of the 2008 Planning Act and the policies and protections set out in the draft NPS provide for a balanced consideration of impacts and benefits. The requirement for the identification of positive and adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for consideration of noise issues. This section also provides detail on the principles against which the application should be judged in relation to design, environmental, health, safety and security aspects, as noted in Table 1 of the draft NPS. **4.2 Environmental Impact Assessment**– the consideration of proposals within the EIA Regulations and the preparation of an ES (where required) agreed by statutory				

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal

agencies and specifying mitigation measures and enhancement measures will ensure that noise aspects are fully considered, as will the consideration of cumulative effects and interrelationships between effects.

4.3 Habitats Regulations Assessment – no direct relationship identified.

4.4 Alternatives – the identification that reasonable alternatives will be required as part of scheme design and project planning should ensure that noise aspects are taken into account, both in terms of protection and opportunities for mitigation and enhancement.

4.5 Criteria for 'good design for geological disposal infrastructure – attention to good design principles and implementation will be of benefit to noise aspects through the consideration of how a proposed facility interacts with its context. It is acknowledged that good design, in terms of siting and use of appropriate technologies, can help mitigate adverse impacts, such as noise. As drafted, however, the draft NPS could offer a fuller explanation of how this might be achieved, moving beyond the reference points of 'siting and design measures relative to existing landscape and historical character and function' and 'landform' to the integration of noise aspects on site as part of a scheme, as well as broader mitigation measures.

4.6 Climate Change Adaptation – no direct relationship identified.

4.7 Pollution Control and other Environmental Regulatory Regimes – issues relating to discharges or emissions from a proposed project which affect or include, inter alia, noise and vibration will be subject to separate regulation under the pollution control framework or other consenting or licensing regimes. Any activities within the development that are regulated under those regimes will need to obtain the relevant permissions before the activities can be undertaken. The various planning and pollution control systems will act to protect noise aspects, particularly where these are to be considered as part of the judgement on whether the development is an acceptable use of the land, the impacts of that use, with the assumption that pollution control will be properly applied and enforced. The planning and pollution control systems are separate but complementary. Pollution control is concerned with preventing pollution through the use of measures, such as environmental permits, to prohibit or limit the release of substances to the environment from different sources, to the lowest practicable level.

4.8 Common Law Nuisance and Statutory Nuisance – there is a direct relationship in terms of adverse effects arising from noise which may be perceived as a nuisance. During examination, possible sources of nuisance under Section 79(1) of the Environmental Protection Act 1990 and how they may be mitigated or limited are considered by the Examining Authority This will enable the Examining Authority to recommend appropriate requirements that the Secretary of State may wish to include in any subsequent order granting development consent. Possible sources of nuisance under the 1990 Act include, inter alia:

- noise emitted from premises so as to be prejudicial to health or a nuisance;
- noise that is prejudicial to health or a nuisance and is emitted from or caused by a vehicle, machinery or equipment in a street; and
- any other matter declared by any enactment to be a statutory nuisance.

It should be noted that noise caused by aircraft or traffic are not classified as a statutory nuisance with regard to the above, in light of possible aerial surveys that may be carried out.

4.9 Safety – no direct relationship identified.

4.10 Health – noted that where the proposed development has an effect on human beings, the Environmental Statement should assess these effects for each element of the project, including noise, identifying any adverse health impacts and mitigation measures to avoid, reduce or compensate for such impacts as appropriate.

4.11 Security Considerations – no direct relationship identified.

The appraisal of the draft NPS and the reasonable alternatives has identified no substantive difference in effects in terms of noise.

Particular generic impacts are presented separately in the draft NPS and consideration should be given to links between those generic impacts and noise, e.g. noise with traffic and transport and biodiversity.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
`	+	++	+/?	**Draft NPS:** The development of geological disposal infrastructure can be expected to involve the generation of noise which could lead to adverse impacts on sensitive receptors, including habitats and species. Sources of potential noise could arise from, inter alia, the operation of generators and drilling activities, construction vehicles and handling of materials and waste. The draft NPS seeks to minimise noise pollution and the effects of vibration by requiring the identification and assessment of noise aspects though a noise assessment as part of an ES. The Secretary of State must make a decision based on the noise aspects identified and whether mitigation measures are needed, over and above any which may form part of the development consent application. The draft NPS sets out the nature and extent of the noise assessment and how it should be proportionate to the likely noise impact and that the applicant should consult with various statutory bodies and the requirements for the preparation and contents of an ES which should help to ensure that effects are properly considered and appropriate mitigation measures are identified. The draft NPS makes clear that the Secretary of State should not grant consent unless satisfied that the proposal will mitigate and minimise adverse impacts on health and quality of life. It is considered that the draft NPS will have a positive effect on this objective as it will help to minimise noise and vibration effects from GDF-related construction and operational activities, notably on sensitive locations and receptors.
				Draft NPS including Exclusionary Criteria: Positive effects on noise associated with this reasonable alternative are expected to be broadly similar to those identified in respect of the draft NPS above. However, it is considered that the adoption of exclusionary criteria is likely to yield significant positive effects on this objective by introducing protection to the aspects covered by the exclusionary criteria including species and habitats and minimising the direct effects of noise and vibration on those areas. There could be unintended effects due to resulting development pressure on areas peripheral to the specified areas, including places of tranquillity and areas of recreational value and areas not given specific protection. Mitigation measures and enhancement measures would be broadly similar as the exclusionary criteria are considered unlikely to make a difference.
				No NPS: Despite the absence of a guiding framework for noise aspects, this reasonable alternative is likely to result in positive effects on noise as any development would be subject to the provisions of national planning policy, EIA regulations, WHO guidelines for community noise and relevant British Standards. However, the absence of a clear statement regarding the full range of information to be submitted with regards to noise in an ES may mean that opportunities are lost to effectively identify, assess and mitigate noise aspects. Similarly, the absence of a clear statement on the role of the Secretary of State, including ensuring that development avoids significant adverse noise impacts, risks uncertain effects on the receptors and their surroundings. It is considered that mitigation measures would be forthcoming under this reasonable alternative but there is the risk that they would not fully address the range of impacts associated with GDF-related NISPs.
Summary of Recommending Mitigation and Enhancement	Although the draft NPS is considered to have a positive effect in terms of minimising noise and vibration aspects arising from GDF-related activities, the appraisal identifies a number of recommended mitigation measures and enhancement measures that could be applied. In particular, it is suggested that the draft NPS makes a fuller reference to PPG with regards to noise, and makes suggestions and provides further guidance on the information to be used in undertaking a noise assessment. Identified mitigation measures in the draft NPS could be revised to be more specific and clearly reflect the potential effects associated with the key project stages including processes such as an environmental management plan, noise monitoring and best practice measures so as to effectively mitigate any adverse impacts on noise aspects. The draft NPS could also make explicit reference to the need to consider the impact on tranquillity (consistent with PPG Noise, Paragraph 0012 Reference ID 30-012-20140306).			

9. Climatic Factors

Introduction

This section presents the overview of plans, programmes and baseline information for the appraisal of the sustainability of the National Policy Statement for Geological Disposal Infrastructure and reasonable alternatives in respect of climatic factors.

Climate change within this context is concerned with increasing the likelihood of climate change effects through greenhouse gas emissions, and the ability to adapt to the effects of climate change such as the occurrence of more extreme weather events.

There are links between climate change and the majority of other topics in the Appraisal of Sustainability (AoS), including biodiversity and nature conservation, land use, geology and soil, water quality, human health, flood risk, traffic and transport and air quality.

Review of Plans and Programmes

The range of plans and policies reviewed seek to promote both climate change mitigation and adaptation. There are a number of key international agreements in place that seek to mitigate climate change, including most recently the ***Paris Agreement (2015).*** The **Climate Change Act (2008)** puts targets for reducing greenhouse gas emissions on a statutory footing.

Climate change adaptation is actively promoted through the NPPF and associated Planning Practice Guidance. **Adapting Energy, Transport and Water Infrastructure to the Long-term Impacts of Climate Change (2010)** takes a long-term view of adapting infrastructure to climate change.

International/European

The ***United Nations Framework Convention on Climate Change*** (UNFCCC) sets an overall framework for international action to tackle the challenges posed by climate change. The Convention sets an ultimate objective of stabilising greenhouse gas concentrations "*at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system*." The Convention requires the development and regular update of greenhouse gas emissions inventories from industrialised countries, with developing countries also being encouraged to carry out inventories. The countries who have ratified the Treaty, known as the Parties to the Convention, agree to take climate change into account in such matters as agriculture, industry, energy, natural resources and where activities involve coastal regions. The Parties also agree to develop national programmes to slow climate change.

The two main agreements resulting from the UNFCCC to date are the ***Kyoto Protocol (1997)*** and the ***Paris Agreement (2015)***. The Kyoto Protocol sought to establish an international mechanism to reduce emissions of greenhouse gas emissions and in consequence set binding emissions reduction targets for 37 industrialised countries and the European Community. These targets equated to an average of 5% reductions relative to 1990 levels over the five-year period 2008-12. The key distinction between this and the UNFCCC is that the Convention encourages nations to stabilise greenhouse gases while the Kyoto Protocol committed them to doing so through greenhouse gas reductions. It included three market-based mechanisms to

meet these targets: emissions trading; the clean development mechanism (CDM); and Joint Implementation (JI).

The Protocol's first commitment period started in 2008 and ended in 2012. At the Durban conference in December 2011, governments decided that the Kyoto Protocol would move into a second commitment period in 2013, in a seamless transition from the end of the second commitment period in 2012. Governments of Parties to the Kyoto Protocol also made amendments to the Protocol, among others, the range of greenhouse gases covered.

The Paris Agreement (2015) was agreed in December 2015 and, upon ratification by signatories responsible for more than 55% of global greenhouse gas emissions, came into force on 5th October 2016. The Agreement's main aim is to keep a global temperature rise this century "*well below*" 2 degrees Celsius and to drive efforts to limit the temperature increase even further to 1.5 degrees Celsius above pre-industrial levels. The main climate change mitigation delivery mechanism is the submission of five year Nationally Determined Contributions (NDCs) by all signatories with a steadily increasing ambition in the long term.

At the European level, the European Union's (EU) submission to the Paris Agreement establishes an overall binding commitment to reduce domestic greenhouse gas emissions by at least 40% by 2030 compared to 1990, in line with targets set out in the EU 2030 Climate and Energy Policy Framework (October 2014). Given the result of the EU referendum held on 23rd June 2016, in due course it may be necessary for the UK Government to submit separate NDCs to the UNFCCC. However, at the present time the UK remains a member of the EU and is therefore obligated to contribute towards achieving the emissions reduction targets specified in the EU's submission to the Paris Agreement.

In March 2007, the European Union's (EU) leaders endorsed an integrated approach to climate and energy policy that aims to combat climate change and increase the EU's energy security while strengthening its competitiveness. They committed Europe to transforming itself into a highly energy-efficient, low carbon economy. It set a series of demanding climate and energy targets to be met by 2020, known as the "20-20-20" targets. These are:

- a reduction in EU greenhouse gas emissions of at least 20% below 1990 levels;
- 20% of EU energy consumption to come from renewable resources; and
- a 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency.

To secure a reduction in EU greenhouse gases, the ***EU Emissions Trading Scheme (EU ETS),*** a Europe wide scheme was introduced in 2005. EU ETS puts a price on carbon that businesses use and creates a market for carbon. It allows countries that have emission units to spare (emissions permitted to them but not "used") to sell this excess capacity to countries which are likely to exceed their own targets. ***The Integrated Climate and Energy Package*** included a revision and strengthening of the ETS. A single EU-wide cap on emission allowances applied from 2013 and will be cut annually, reducing the number of allowances available to businesses to 21% below the 2005 level in 2020. The free allocation of allowances will be progressively replaced by auctioning, and the sectors and gases covered by the system will be somewhat expanded.

The ***Seventh EU Environmental Action Plan (EAP) (2013-2020)*** reviews the significant environmental challenges and provides a framework for European environmental policy up to 2020. The programme identifies three priority areas where more action is needed to protect nature and strengthen ecological resilience, boost resource-efficient, low-carbon growth, and

reduce threats to human health and well-being linked to pollution, chemical substances, and the impacts of climate change.

The ***Renewable Energy Directive (2009/28/EC)*** mandates levels of renewable energy use within the EU. The Directive requires EU Member States to produce a pre-agreed proportion of energy consumption from renewable sources such that the EU as a whole shall obtain at least 20% of total energy consumption from renewables by 2020. This is then apportioned across Member States. The UK's target is for 15% of energy consumption in 2020 to be from renewable sources. Under Article 4 of the Directive, each Member State is also required to adopt a National Renewable Energy Action Plan that will set out the trajectory and measures that will enable the target to be met.

The ***Energy Efficiency Directive (2012/27/EU)*** sets the framework for measures to promote energy efficiency across the EU and help the EU reduce its energy consumption by 20%.

EU leaders agreed on 23 October 2014 the domestic 2030 greenhouse gas reduction target of at least 40% compared to 1990 together with the other main building blocks of the ***2030 Policy Framework for Climate and Energy***, as proposed by the European Commission in January 2014. This 2030 policy framework aims to make the EU's economy and energy system more competitive, secure and sustainable and also sets a target of at least 27% for renewable energy and energy savings by 2030.

The Commission adopted the ***EU Strategy on Adaptation to Climate Change*** in April 2013. The Strategy has three key objectives:

- Promoting action by Member States: The Commission will encourage all Member States to adopt comprehensive adaptation strategies and will provide funding to help them build up their adaptation capacities and take action.
- 'Climate-proofing' action at EU level by further promoting adaptation in key vulnerable sectors such as agriculture, fisheries and cohesion policy, ensuring that Europe's infrastructure is made more resilient, and promoting the use of insurance against natural and man-made disasters.
- Better informed decision-making by addressing gaps in knowledge about adaptation and further developing the European climate adaptation platform (Climate-ADAPT) as the 'one-stop shop' for adaptation information in Europe.

UK

In the UK, the ***Climate Change Act 2008*** introduced legislative targets for reducing the UK's impacts on climate change and the need to prepare for its impacts. The Act sets binding targets for a reduction in CO_2 emissions of 80% by 2050, compared to a 1990 baseline. Interim targets and five-year carbon budget periods are used to ensure progress towards the 2050 target. The Climate Change Act 2008 also requires the Government, on a regular basis, to assess the risks to the UK from the impact of climate change and report to Parliament. The UK Committee on Climate Change Adaptation Sub-committee is responsible for preparing these climate change risk assessments, the latest of which, the second UK Climate Change Risk Assessment (CCRA2) Evidence Report, was published in July 2016[283].As required under sections 12 and 14 of the Climate Change Act 2008, ***The Carbon Plan: Delivering our Low Carbon Future (2011)*** sets out proposed measures to implement the UK's first four carbon

[283] UK CCC ASC (2016) *UK Climate Change Risk Assessment 2017: CCRA2 Evidence Report.* Available online at: https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/

budgets and thereby achieve a 50% reduction in the UK's annual net carbon account by 2027 (from 1990 levels). The plan builds upon the previous Low Carbon Transition Plan (2009) and includes proposals for energy efficiency, heating, transport and industry.

On 30th June 2016 the UK Government confirmed its intention set the Fifth Carbon Budget to reduce UK greenhouse gas emissions by 57% by 2030 relative to 1990 levels[284]. This is in line with advice provided to the UK Government by the UK Committee on Climate Change, and in due course a report on policies and proposals to achieve this Fifth Carbon Budget will need to be laid before the UK Parliament.

In relation to the decarbonisation of the energy generation sector, the UK Government's ***Renewables Strategy (2009)*** sets out the path for the UK to meet the legally-binding target (under the Renewable Energy Directive (2009/28/EC)) to ensure 15% of energy comes from renewable sources by 2020. The ***UK Renewable Energy Roadmap Update 2013*** provides the latest available analysis regarding achievements and changes that have taken place in pursuit of achieving this target. The update includes energy demand and technology cost projections, as well was a 'bottom up' review of projects that could well come forward.

The ***Energy Act 2013*** establishes a legislative framework for delivering secure, affordable and low carbon energy and includes provisions on: decarbonisation; electricity market reform; nuclear regulation; government pipe-line and storage system; and consumer protection amongst others.

On the 23rd June 2011, the Department for Energy and Climate Change (now BEIS) designated the ***National Policy Statements*** (NPS) for energy infrastructure. These statements set out the Government's policy for delivery of major energy infrastructure. NPS ***EN-1*** sets out the Government's overall policy for delivery of major energy infrastructure. A further five technology-specific NPSs for the energy sector cover: fossil fuel electricity generation (***EN-2***); renewable electricity generation (both onshore and offshore) (***EN-3***); gas supply infrastructure and gas and oil pipelines (***EN-4***); the electricity transmissions and distribution network (***EN-5***); and nuclear electricity generation (***EN-6***).

England

The ***National Planning Policy Framework (Department for Communities and Local Government, 2012)*** provides a set of core land-use planning principles that should underpin both plan-making and decision-taking. These include supporting "the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change, and encourage the re-use of existing resources, including conversion of existing buildings, and encourage the use of renewable resources (for example, by the development of renewable energy)". The NPPF underlines that planning's role in tackling climate change is central to the economic, social and environmental dimensions of sustainable development. Local planning authorities are therefore expected to adopt proactive strategies to mitigate and adapt to climate change (in line with the objectives and provisions of the Climate Change Act 2008), taking full account of flood risk, coastal change and water supply and demand considerations.

To support the move to a low carbon future, local planning authorities are expected to plan for new development in locations and ways which reduce greenhouse gas emissions; actively support energy efficiency improvements to existing buildings and have a positive strategy to

[284] UK Committee on Climate Change (2016) *CCC welcomes Government backing for fifth carbon budget and continued ambition to meet 2050 target*. Available online at: https://www.theccc.org.uk/2016/06/30/ccc-welcomes-government-backing-for-fifth-carbon-budget-and-continued-ambition-to-meet-2050-target/

promote energy from renewable and low carbon sources. Local Plans are also expected to take account of climate change over the longer term, including factors such as flood risk, coastal change, water supply and changes to biodiversity and landscape. New development should be planned to avoid increased vulnerability to the range of impacts arising from climate change.

The section of ***Planning Practice Guidance (2014)*** regarding Climate Change advises how planning can identify suitable mitigation and adaptation measures in plan-making and the application process to address the potential impacts of climate change. This includes potential climate change adaptation options such as the availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality.

In 2010 Defra published **Adapting Energy, Transport and Water Infrastructure to the Long-term Impacts of Climate Change.** The report sets out the case for adapting infrastructure in the energy, transport and water sectors so that new and existing infrastructure is able to operate effectively in a long-term changing climate. The report focuses on the long-term impacts of climate change (2030s to 2100) to infrastructure in the 3 sectors (but which could also apply to geological disposal infrastructure), setting out:

- the long-term risks from climate to the infrastructure, both technically and operationally;
- the need to consider the interdependency risks of the infrastructure system and how this can be exacerbated by long-term climate change;
- the need for all infrastructure to consider the long-term impacts of climate change in its design, build and operation;
- the adaptation options available, as well as barriers possibly preventing action; and
- suggested recommendations to the Infrastructure and Adaptation project as part of its 2-year programme of work.

Scotland

The ***Climate Change (Scotland) Act 2009*** sets binding net carbon emission reduction targets of 42% by 2020 and 80% by 2050 compared with 1990 levels, and also requires Scottish Ministers to meet annual emission reductions targets in line with a trajectory towards the 2050 target. Taken together, the Climate Change (Annual Targets) (Scotland) Orders of 2010, 2011 and 2016 specify annual emission reduction targets until 2032. All of these targets relate to a basket of six greenhouse gases recognised by the UNFCCC and includes Scotland's share of emissions from international aviation and international shipping. In addition, section 44 of the Act requires all public bodies, including planning authorities and the Scottish Government itself, to "act in the way best calculated to contribute to the delivery of the emissions targets". ***A Low Carbon Economic Strategy for Scotland: Scotland – A Low Carbon Society (2011)*** is an integral part of the Scottish Government's Economic Strategy to secure economic growth, and a key component of the broader approach to meet Scotland's climate change targets and secure the transition to a low carbon economy in Scotland.

The ***Electricity Generation Policy Statement – 2013 (EGPS)*** examines the way in which Scotland generates electricity, and considers the changes which will be necessary to meet the targets which the Scottish Government has established, and reflects both views from industry and other stakeholders and also developments in UK and EU electricity policy. It looks at the sources from which that electricity is produced, the amount of electricity which we use to meet

our own needs and the technological and infrastructural advances and requirements which Scotland will require over the coming decade and beyond.

On the 27th June 2013 the Scottish Government published the report ***Low Carbon Scotland: Meeting our Emissions Reduction Targets 2013-2027: The Second Report on Proposals and Policies (RPP2)***. This fulfils the duty place on Scottish Ministers by Section 35 of the Climate Change (Scotland) Act 2009, to lay before the Scottish Parliament a Report on Proposals and Policies setting out specific measures for reducing greenhouse gas emissions to meet Scotland's ambitions statutory targets. The RPP2 is structured around the key sectors of energy supply, homes and communities, business and the public sector, transport, waste and rural land use. For each of these sectors, policies to reduce greenhouse gas emissions are identified, as are a number of proposals for further consideration and development. Taken together, these policies and proposals show that it is possible to meet the climate change targets established by the Climate Change (Scotland) Act 2009.

The ***2020 Route map for Renewable Energy in Scotland (2011)*** is an update and extension to the ***Scottish Renewables Action Plan 2009***. This updated and expanded Route map reflects the challenge of the new target to meet an equivalent of 100% demand for electricity from renewable energy by 2020, as well as the target of 11% renewable heat.

The ***Scottish Planning Policy (SPP) (2014)*** sets out that the planning system should:

- Support the transformational change to a low carbon economy, consistent with national objectives and targets, including deriving:
    - 30% of overall energy demand from renewable sources by 2020;
    - 11% of heat demand from renewable sources by 2020; and
    - the equivalent of 100% of electricity demand from renewable sources by 2020.
- Support the development of a diverse range of electricity generation from renewable energy technologies – including the expansion of renewable energy generation capacity – and the development of heat networks.
- Guide development to appropriate locations and advise on the issues that will be taken into account when specific proposals are being assessed.
- Help to reduce emissions and energy use in new buildings and from new infrastructure by enabling development at appropriate locations that contributes to:
    - energy efficiency;
    - heat recovery;
    - efficient energy supply and storage;
    - electricity and heat from renewable sources; and
    - electricity and heat from non-renewable sources where greenhouse gas emissions can be significantly reduced.

Scotland's Third National Planning Framework (NPF) (2014) is a long-term strategy for Scotland. It is the spatial expression of the Government Economic Strategy, and the plans for development and investment in infrastructure. NPF identifies national developments and other strategically important development opportunities in Scotland. It is accompanied by an Action Programme which identifies how they expect it to be implemented, by who, and when. Their ambition is to achieve at least an 80% reduction in greenhouse gas emissions by 2050 and

foresee that planning will play a key role in delivering on the commitments set out in Low Carbon Scotland: the Scottish Government's report on proposals and policies (RPP2). The priorities identified in the NPF set a clear direction of travel which is consistent with their climate change legislation.

Wales

Energy Wales: A Low Carbon Transition (2012) sets out the Welsh Government's aim to enhance the economic, social and environmental wellbeing of the people and communities of Wales – to achieve a better quality of life for our own and future generations. As set out in the Programme for Government, their ambition is therefore to: 'create a sustainable, low carbon economy for Wales'. In doing so, they want to ensure full advantage is taken of the transition to a low carbon economy to secure a wealthier, more resilient and sustainable future for Wales.

The Welsh Assembly Government have a clear role to play in tackling climate change. ***Climate Change Strategy for Wales (2010)*** and its associated delivery plans set targets to reduce greenhouse gas emissions in Wales by 3% every year and achieve at least a 40% reduction by 2020 compared to figures from 1990, as well as establishing measures to address climate change adaption.

Part 2 of the ***Environment (Wales) Act 2016*** establishes a statutory framework for action on climate change, including targets for reducing emissions of greenhouse gasses and associated duties. The Welsh Ministers are required to ensure that the 'net Welsh emissions account' for the year 2050 is at least 80% lower than the baseline, set at 1990 emissions levels, and they must also specify in regulations interim targets for 2020, 2030 and 20240 and set five yearly carbon budgets. The targets must be set after the Welsh Ministers have received advice from the UK CCC, and the Welsh Ministers must produce a report detailing the policies and proposals that will deliver emissions reductions necessary to meet the interim and overall targets, as well as regular progress reports. The Act also contains a range of other provisions regarding the sustainable management of natural resources, specifically including measures to enhance resilience.

Planning Policy Wales (Edition 9, 2016) (PPW) sets out several objectives in respect of climate change mitigation and adaptation. It promotes:

- Planning to minimise the causes of climate change by taking decisive action to move towards a low carbon economy by proactively reducing the demand for energy, facilitating the delivery of new and more sustainable forms of energy provision at all scales and minimising the emissions of greenhouse gases to the atmosphere.
- Planning for the consequences of climate change.

PPW is supported by the following Technical Advice Notes (TANs) that are particularly relevant to climate change:

- TAN 8: Renewable Energy (2005);
- TAN12: Design (2016); and,
- TAN 15: Development and Flood Risk (2004).

Overview of the Baseline

International

Climate

The UNFCCC, Paris Agreement and other international measures to combat climate change are influenced by regular reports from the Intergovernmental Panel on Climate Change (IPCC). The IPCC's ***Fifth Assessment Report***[285] (referred to as AR5) provides the most up to date view of scientific knowledge regarding climate change and in summary concludes that:

- unprecedented atmospheric concentrations of carbon dioxide, methane and nitrous oxide, resulting from industrial activities including fossil fuel combustion, are "extremely likely to have been the dominant cause of the observed warming since the mid-20th century". Total anthropogenic greenhouse gas (GHG) emissions were the highest in human history from 2000 to 2010 and the energy supply sector generated 25% of total GHG emissions in 2010; and,
- climate change risks and impacts "can be reduced by limiting the rate and magnitude of climate change". AR5 calls for low carbon energy technologies to generate more than 80% of electricity by 2050 and for unabated fossil fuel generation to be virtually phased out by 2100.

UK

Climate

The UK is presently influenced by predominantly westerly tracking storm systems throughout the year. Variations in temperature, precipitation and wind speeds may be partly accounted for by exposure, latitude and altitude. The surrounding seas also have a significant effect on the national and local weather conditions. The temperatures of air masses reaching the UK have been modified by the ocean such that the UK tends to experience lower summer temperatures than mainland Europe, but milder winters. In the recent past, the Central England temperature has risen ~1°C since 1970, and Scottish temperatures have risen 0.8°C since 1980.

All areas of the UK are getting warmer, and the warming is greater in summer than in winter[286]. There is little change in the amount of precipitation (rain, hail, snow, etc.) that falls annually, but more is falling in the winter, with drier summers, for much of the UK. Sea levels are rising, and are greater in the south of the UK than the north. Widespread flooding events cannot be directly attributed to climate change but it is expected to see more extreme rainfall events in the future, and hence more flooding as the climate changes.

The UK is experiencing sea level rise of approximately 1mm per year. Global sea-level is rising at about 3mm per year[287]. Sea-surface temperatures around the UK coast have risen over the past three decades by about 0.7ºC. Global average temperatures are rising at about 0.2ºC per decade. Severe windstorms around the UK have become more frequent in the past

[285] Intergovernmental Panel on Climate Change (2015) *Synthesis Report - Summary for Policymakers*. Available online at: http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf
[286] Defra (2009*) Adapting to climate change – UK Climate Projections*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69257/pb13274-uk-climate-projections-090617.pdf
[287] UK Climate Impact Projects (2009) *The climate of the UK and recent trends*. Available online at: http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87933&filetype=pdf

few decades, though not above that seen in the 1920s. Annual mean precipitation over England and Wales has not changed significantly since records began; however seasonal rainfall appears to be decreasing in summer and increasing in winter. More specifically, the following observations can be made:

- Central England temperature has risen by about one degree Celsius since the 1970s, with 2006 being the warmest on record. All regions of the UK have experienced an increase in average temperatures between 1961 and 2006 annually, and for all seasons. Increases in annual average temperature are typically between 1.0 and 1.7°C, tending to be largest in the south and east of England and smallest in Scotland.
- All regions of the UK have experienced an increase over the past 45 years in the contribution to winter rainfall from heavy precipitation events; in summer all regions except north east England and north Scotland show decreases.
- Severe windstorms around the UK have become more frequent in the past few decades, though not above that seen in the 1920s.
- There has been considerable variability in the North Atlantic Oscillation, but with no significant trend over the past few decades.
- Sea-surface temperatures around the UK coast have risen over the past three decades by about 0.7ºC.
- Sea level around the UK rose by about 1 mm/yr in the 20th Century, corrected for land movement. The rates for the 1990s and 2000s have been higher than this.
- The annual number of days with air frost has reduced in all regions of the UK between 1961 and 2006. There are now typically between 20 and 30 fewer days of air frost per year, compared to the 1960s, with the largest reductions in northern England and Scotland.
- There has been a decrease in the average number of Heating Degree Days (HDD), and an increase in the average number of Cooling Degree Days (CDD) in all administrative regions of the UK as a whole, between 1961 and 2006.
- There has been a slight increase in average annual precipitation in all regions of the UK between 1961 and 2006, however this trend is only statistically significant above background natural variation in Scotland where an increase of around 20% has been observed. Likewise, an increase in average winter precipitation is only statistically significant in northern England and Scotland where increases of 30-65% have been experienced.
- Average annual and seasonal relative humidity has decreased in all regions of the UK, except Northern Ireland, between 1961 and 2006, by up to 5%.

The ***second UK Climate Change Risk Assessment (CCRA2) Evidence Report (2016)***[288] reviews a range of evidence sources, including the UK Climate Impact Projections 2009 (UKCIP09), and concludes that climate change is already affecting both the natural and built environments across the UK.

[288] UK CCC ASC (2016) *UK Climate Change Risk Assessment 2017: CCRA2 Evidence Report.* Available online at: https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/

Energy

The ***Digest of UK Energy Statistics 2016***[289] provides the latest official statistics regarding energy generation/production capacity and consumption across the UK in 2015. Key statistics of relevance include:

- In 2015 primary energy production rose by 9.6 per cent compared with a year earlier, its first increase since 1999, as output of oil and gas from the UK Continental Shelf had both increased. Low carbon sources including nuclear, wind, solar photovoltaics and bioenergy all grew strongly. Coal output though was down to a record low level owing to recent mine closures.
- Final energy consumption rose by 0.4 per cent, reflecting the cooler weather in 2015 compared to 2014. On a temperature adjusted basis, final energy consumption was down 0.8 per cent continuing the downward trend of the last ten years.
- Electricity generated from renewable sources in the UK in 2015 increased by 29 per cent on a year earlier, and accounted for 25 per cent of total UK electricity generation, up from 19.1 per cent in 2014. Total renewables, as measured by the 2009 EU Renewable Energy Directive, accounted for 8.3 per cent of energy consumption in 2015, up from 7.1 per cent in 2014.
- The UK remained a net importer of energy, though with a decreased dependency level (imports / energy use) of 38 per cent; this continues the trend from 2004 when the UK once again became a net importer of fuel. In 2015 the UK was a net importer of all main fuels types.
- In 2015, gas was the main fuel used for electricity generation, with its share remaining at 30 per cent. Coal's share decreased from 30 per cent to 22 per cent, whilst nuclear's share increased to 21 per cent following outages in the second half of 2014.

In 2015, the nuclear sector used 4.89 terawatt-hours (TWh) of energy. This is an increase of 6.2% since 2014 and is largely associated with the electricity generation sub-sector, which increased supplies by 11.9% to 47.8 TWh. The ratio of energy consumed to electricity produced by the electricity generation sub-sector improved from 14.2% to 13.5%. 13,197,000m^3 of water was consumed, an increase of 2.9% against 2014 because of operational demands at sites in the defence sub-sector and fuel reprocessing sector. The electricity generation sub-sector used 1.5% less water. There was a calculated 14% decrease in the total volume of carbon dioxide (CO2) emissions in 2015. The estimate is sensitive to changes from year to year in the different fuel sources used to generate electricity nationwide.[290]

Greenhouse Gas (GHG) Emissions

The Climate Change Act 2008 prescribes that the UK's GHG inventory covers the six direct greenhouse gases under the Kyoto Protocol, namely:

- Carbon dioxide (CO2);

[289] DECC (2016) *Digest of UK Energy Statistics 2016.* Available online at: https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

[290] Environment Agency (2016) *Nuclear Sector Plan: 2015 Environmental Performance Report.* Available online at https://www.gov.uk/government/publications/nuclear-industry-environmental-performance-reports

- Methane (CH4);
- Nitrous oxide (N2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulphur hexafluoride (SF6).

These gases contribute directly to climate change owing to their positive radiative forcing effect. HFCs, PFCs and SF6 are collectively known as the 'F-gases'. In general terms, the largest contributor to global warming is CO_2 which makes it the focus of many climate change initiatives. Methane and nitrous oxide contribute to a smaller proportion, typically <10%, and the contribution of F-gases is even smaller (in spite of their high Global Warming Potentials) at <5% of the total. The Climate Change Act 2008 requires an 80% reduction in the UK's 'net carbon account' by 2050, covering all six of the individual greenhouse gases listed above.

The latest official statistics regarding greenhouse gas emissions covered under the Climate Change Act 2008 were provided by the Department for Business, Energy and Industrial Strategy in the ***Annual Statement of Emissions (2017)***. This statistical publication notes that:

- In 2015, net UK emissions were 495.7 million tonnes carbon dioxide equivalent (MtCO2e). This is a 38% reduction in GHG emissions from 1990 year and includes 32% reduction in Carbon Dioxide and 61% in Methane.
- Between 2013 and 2014, the largest decreases came from the energy supply sector, down 13.6 percent (25.7 MtCO2e) due to a decrease in the use of coal for electricity generation; and the residential sector, down by 17.0 percent (13.1 MtCO2e) due to a reduction in use of natural gas for space heating. Demand for heating was lower in 2014 due to the temperature being 1.2 degrees Celsius warmer on average than 2013.
- Carbon dioxide (CO2) is the main greenhouse gas, accounting for 82 percent of total UK greenhouse gas emissions in 2014. In 2014, UK net emissions of carbon dioxide were estimated to be 422.0 million tonnes (Mt). This was around 8.9 percent lower than the 2013 figure of 463.3 Mt. Around half of this decrease was due to 2014 being a warmer year than 2013.

England

Greenhouse Gas inventories for England, Scotland, Wales and Northern Ireland: 1990 – 2014 (2017)[291] presents the latest estimates of greenhouse gas (GHG) emissions for the UK Devolved Administrations (DAs): England, Scotland, Wales and Northern Ireland.

With specific regard to England, it had a 76% share of total net UK GHG emissions in 2015. England has seen a decrease of 41% in greenhouse gas emissions between 1990 and 2015 with a reduction of approximately 5% between 2014 and 2015. This has predominantly driven by a reduction in emissions from the use of coal in the power generation sector and natural gas in the residential sector, with a reduction in emissions from anaerobic managed waste disposal

[291] Ricardo Energy & Environment for the Department of Energy and Climate Change, The Scottish Government, The Welsh Government and The Northern Ireland Department for Agriculture, Environment and Rural Affairs (2017) *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990 – 2015. 2017*. Available online at: http://naei.defra.gov.uk/reports/reports?report_id=932

sites also making a substantial contribution. Greenhouse gas (GHG) emissions for England in 2015 totalled 368,812 $ktCO_2e$, with the dominant emission sources being electricity production (21% of total GHG emissions), cars (15%), residential combustion for heating and cooking (14%). Key sectoral trends in England up to 2015 were:

- Emissions from the energy supply sector decreased by 54% between 1990 and 2015, with a 19% decrease in overall emissions between 2014 and 2015. This decrease was mainly due to a reduction in the use of coal in the power generation sector.
- Emissions from the industrial process sector decreased significantly since 1990 by 84% mainly as a result of a declining chemical and fluorocarbon production industry.
- Emissions from the waste management sector significantly declined by 73% since 1990, largely due to the progressive introduction of methane capture and oxidation systems within landfill management. Emissions decreased by 8% between 2014 and 2015, primarily due to UK-wide reductions in methane emission estimates from landfill due to improved management systems.
- Emissions from the business sector reduced by 24% since 1990 as a result of reduced emissions in manufacturing industries (led by chemicals, non-ferrous metals and other manufacturing) through industrial decline and efficiency improvements. Emissions have recently remained relatively stable, decreasing by 2% between 2014 and 2015.
- Emissions from the residential sector decreased by 15% since 1990 as a result of a switch from less efficient solid and liquid fuels to natural gas for heating, and improvements in energy efficiency. Emissions between 2014 and 2015 increased by 4primarily as a result of an increased energy demand for natural gas for residential heating.
- Emissions from the agricultural sector reduced by 20% since 1990 mainly due to reductions in fertiliser use and resulting nitrous oxide emissions from soils, and reduced animal numbers resulting in reduced methane from dairy cattle. There was a negligible change in agricultural emissions from 2014 to 2015.
- The Land Use, Land Use Change and Forestry (LULUCF) sector was a source of emissions between the Base Year and 2003 after which the LULUCF sector was a sink. This was as a result of significant decreases in the conversion of land to cropland and settlements, and an increase in grassland carbon storage. This change to a sink was slowed by increased carbon emissions from cropland activities and the harvesting of some of the forest carbon stocks. The net sink increased by 3% between 2014 and 2015 as a result of changes in harvested wood products.
- Emissions from the transport sector decreased by 3% between 1990 and 2015 due to improvements in efficiency of transport vehicles despite growth in transport demand over the period. Emissions between 2014 and 2015 increased by 2% mainly due to increasing emissions from light/heavy lorries and buses.
- Emissions from the public sector reduced by 38% since the Base Year. This is due to increased energy efficiency measures and the switch to gas-fired heating. . There was a negligible change in public sector emissions from 2014 to 2015.

Scotland

Greenhouse Gas Emissions

Scottish Greenhouse Gas Emissions 2015[292] provides the latest estimates of greenhouse gas emissions in Scotland for the years 1990 to 2015 and also provides information on the nation's performance against emissions reduction targets set under the Climate Change (Scotland) Act 2009. This publication notes that in 2015, Scottish source emissions of the basket of greenhouse gases are estimated to be 48.1 million tonnes carbon dioxide equivalent (MtCO2e). This is 3.0 per cent lower than the 2014 figure of 49.5 MtCO2e, a 1.5 MtCO2e decrease. The main contributor to this reduction between 2014 and 2015 is:

- fall in energy supply emissions (such as power stations) (1.7 MtCO2e; 12.0 per cent reduction)

Between 1990 and 2015, there was a 37.6 per cent reduction in estimated emissions, a 28.9 MtCO2e decrease. The 3 main contributors to this reduction are:

- fall in energy supply emissions (such as power stations) (10.5 MtCO2e; 46.4 per cent reduction);
- fall in business and industrial process emissions (such as manufacturing) (5.8 MtCO2e; 40.2 per cent reduction);
- fall in waste management emissions (such as landfill) (4.2 MtCO2e; 74.9 per cent reduction).

However, the adjusted emissions to account for Scotland's participation in EU-wide emissions trading and are used to measure progress against targets show a 1.8% increase in emissions. Despite the increase, The Climate Change (Scotland) Act 2009 provides for a fixed annual target for 2015 of 45.928 MtCO2e, which was met.

Energy

Energy in Scotland 2017[293] states that renewable has more than trebled since the end of 2006 and is now equivalent to over half of the electricity consumed in Scotland. Already met the 2020 target to install 500 MW of community and locally owned renewable generation capacity. Renewable heat output is nearly 5 times the level it was in 2008/09.

Wales

Greenhouse Gas inventories for England, Scotland, Wales and Northern Ireland: 1990-2014 (2017)[294] provides the latest estimates of greenhouse gas emissions in Wales, up to the year 2015. This publication notes that total emissions from Wales reduced between 1990 and 2015 by 20%. These emission reductions are mainly due to efficiencies in energy generation and business sector heating, the use of natural gas to replace some coal and other fuels as well as abatement in some chemical industries, and variations in manufacturing output (e.g. in iron and steel, bulk chemical production). Total greenhouse emissions decreased between

[292] Scottish Government (2017) *Scottish Greenhouse Gas Emissions 2015.* Available online at: http://www.gov.scot/Resource/0052/00520839.pdf
[293] Scottish Government (2017) *Energy in Scotland 2017*. Available online at: http://www.gov.scot/Resource/0051/00514474.pdf
[294] Ricardo Energy & Environment for the Department of Energy and Climate Change, The Scottish Government, The Welsh Government and The Northern Ireland Department for Agriculture, Environment and Rural Affairs (2017) *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990 – 2015. 2017*. Available online at: http://naei.defra.gov.uk/reports/reports?report_id=932

2014 and 2015 by 1%. This net figure is a balance between large reductions in emissions in some sectors, such as iron and steel, balanced aged increases in other sectors such as home energy use. Further details from the inventory include:

- Emissions from the energy supply sector decreased by 3% between 1990 and 2014 due to decreases in emissions from power stations. There was a negligible change in energy supply sector emissions from 2014 to 2015.
- Emissions from the transport sector only decreased by 1% between 1990 and 2014 despite improvements in efficiency of transport vehicles, as a result of growth in transport demand since 1990 and increased affordability of cars over the period. Emissions between 2014 and 2015 increased by 2% mainly due to increasing emissions from light/heavy lorries and buses.
- Emissions from the residential sector decreased by 26% since 1990 partly due to a change in the fuel mix from coal towards natural gas and also energy efficiency measures. Emissions between 2014 and 2015 increased by 2% mainly as a result of an increased demand for heating.
- Emissions from the business sector reduced by 35% since 1990, with a 7% reduction between 2014 and 2015. The trends in this sector are primarily driven by the activities from the iron and steel industry.
- Emissions from the public sector reduced by 57% since 1990. This is due to increased energy efficiency measures and fuel switching from more carbon-intensive fuels such as coal and oil to natural gas. Emissions between 2014 and 2015 increased by 2%.
- Emissions from the industrial process sector decreased by 2% since 1990 and have shown significant fluctuations during this timeframe reflecting manufacturing output and abatement installations. The trend is heavily influenced by iron and steel production.
- Emissions from the agricultural sector reduced by 15% since 1990 mainly due to a decrease in livestock numbers. There was a small increase of 1% in emissions from 2014 to 2015 mainly due to an increase in the number of dairy cattle and sheep.
- Emissions from the waste management sector significantly declined by 72% since 1990, largely due to the progressive introduction of methane capture and oxidation systems within landfill management. Emissions continued to fall between 2014 and 2015, decreasing by 1%.

The Welsh Government's ***Sustainable Development and Climate Change Annual Report (2016)***[295] provides the official overview of greenhouse gas emissions trends and determines the progress made in reducing greenhouse gas emissions in Wales against pre-defined targets, namely to reduce emissions by 3% annually in areas of devolved competence and to reduce overall emissions by 40% by 2020.

The baseline emissions figure for the 3% annual reduction target is 34.53 $MtCO_2e$. In 2013, the emissions were 29.46 $MtCO_2e$ which equates to a decrease from the baseline of 14.7%. This

[295] Welsh Government (2016) *Sustainable Development and Climate Change Annual Report*. Available online at: http://gov.wales/docs/desh/publications/160315-sustainable-development-and-climate-change-annual-report-2015-en.pdf

reduction is therefore in excess of the 3% reduction target of 9% for 2013. The most significant reductions occurring in waste (-14.5%) and the devolved public (- 13.6%) sectors.

With regards to the 40% reduction target in overall emissions, emissions in Wales have declined from the baseline to 50.76 $MtCO_2e$ in 2013. This represents an 11.9% reduction in total emissions since the baseline. It also shows that in 2013 emissions in Wales rose by 10.3% compared with 2012 driven predominantly by an increase in emissions from the iron and steel sector due to the restart of Tata Steel's Port Talbot No.4 Blast Furnace in February 2013, and a shift from natural gas to coal use in power stations.

Summary of Existing Problems Relevant to the Geological Disposal NPS

The following existing problems for climatic factors have been identified:

- The input of greenhouse gasses (e.g. CO2, CH4, N2O, O3) resulting from fossil fuel usage, agriculture and other land use have been linked with atmospheric warming and undesirable climate change.
- Fossil fuel dependency remains high and is likely to remain so for some time.
- Legally binding EU and government targets (see: the Climate Change Act 2008 and subsequent revisions: The Climate Change Act 2008 (2020 Target, Credit Limit and Definitions) Order 2009, The Carbon Budgets Order 2009) seek to reduce emissions (based on a carbon budget of MtCO2 equivalent) by 80% on 1990 levels by 2050, with an interim target of 34% by 2020. The UK Government has confirmed its intention within the Fifth Carbon Budget to reduce UK greenhouse gas emissions by 57% by 2030 relative to 1990 levels.
- The UK's Climate Projections (UKCP09) show that the UK as a whole is likely to experience hotter, drier summers, warmer, wetter winters and rising sea levels, particularly in the south east of England. This is likely to have a significant effect on a range of environmental conditions.
- Sensitive ecosystems and UK water resources are likely to come under increasing pressure as a result of climate change.
- Changes in temperature and rainfall patterns, along with more frequent extreme weather events creates the situation where a greater degree of resilience will have to be incorporated into plans and proposals.

Likely Evolution of the Baseline

UK

Climate

UKCP09 provides the following predictions on changes to climate within the UK based on a medium emission scenario with 90% probability[296]:

[296] UK Climate Projections (2014) *Maps and key findings*. Available online at:

- 2080 mean winter temperature: the central estimates of change are projected to be generally between 2 and 3ºC across most of the country, with slightly larger changes in the south-east and slightly smaller in the north-west of Britain;
- 2080 mean summer temperature: a more pronounced south to north gradient exists with changes in some parts of southern England being just over 4ºC and in parts of northern Scotland about 2.5ºC;
- 2080 mean summer daily maximum temperature: central estimates show a gradient between parts of southern England, where they can be 5ºC or more, and northern Scotland, where they can be somewhat less than 3ºC;
- 2080 mean annual precipitation: shows little change (few percent or zero);
- 2080 mean winter precipitation: increases are in the range +10 to +30% over the majority of the country. Increases are smaller than this in some parts of the country, generally on higher ground;
- 2080 mean summer precipitation: general south to north gradient, from decreases of almost 40% in south west England to almost no change in Shetland;
- the range of absolute sea level rise around the UK (before land movements are included) and across the three emissions scenarios is projected to be between 12 and 76cm for the period 1990-2095, which is a wider spread than that of the global average;
- the projected long-term future trends in storm surge found in UKCP09 are physically small everywhere around the UK, and in many places can be accounted for by natural variability. The surge level is expected to be exceeded on average once in 2, 10, 20 or 50 years is not projected to increase by more than 9cm by 2100 anywhere around the UK coast (not including the mean sea level change). The largest trends are found in the Bristol Channel and Severn Estuary;
- seasonal mean and extreme waves are generally expected to increase in the south west of the UK, reduce to the north of the UK and experience a small change in the southern North Sea. Changes in the winter mean wave height are projected to be between –35 and +5cm. Changes in the annual maxima are projected to be between –1.5 and +1m.

It should be noted that the CCRA also includes an H++ scenario concept to represent low likelihood, high end outcomes that cannot be ruled out based on current understanding. Whilst not considered the most likely evolution of the baseline, it is an important consideration for the NPS.

In general, H++ scenarios can consist of both quantitative information derived from climate models, and qualitative narrative derived from theoretical insight, understanding of processes missing from models, and/or past observations. The scenarios are of low but unspecified probability, and are useful for thinking about the limits of different adaptation strategies or contingency planning. For sea level rise, the existing H++ scenario included in UKCP09 remains in use. This gives an upper limit of around 1.9 metres for sea level rise by 2100. Met Office (2015) for the ASC provides new H++ scenarios for aspects of UK terrestrial climate. It

http://ukclimateprojections.defra.gov.uk/21708#key

suggests that by the end of the 21st century, the UK could plausibly see heatwaves of 50 days duration with a mean temperature of almost 40°C and increasingly intense summer droughts with rainfall 60% below average. These droughts could be accompanied by severe reductions of up to 70% in 'Q95', an index of low river flow defining a level exceeded 95% of the time. Winter rainfall could increase by up to 100%, suggesting that winters like 2013/14, with 70% more than average rainfall, could conceivably be exceeded in most years by the 2080s. Daily intense rainfall could also increase in both summer and winter, with a possible increase of 60 to 80% compared to current intense rainfall events. As a result of this increased rainfall, peak river flows could be up to three times higher than they are now, by the 2080s.

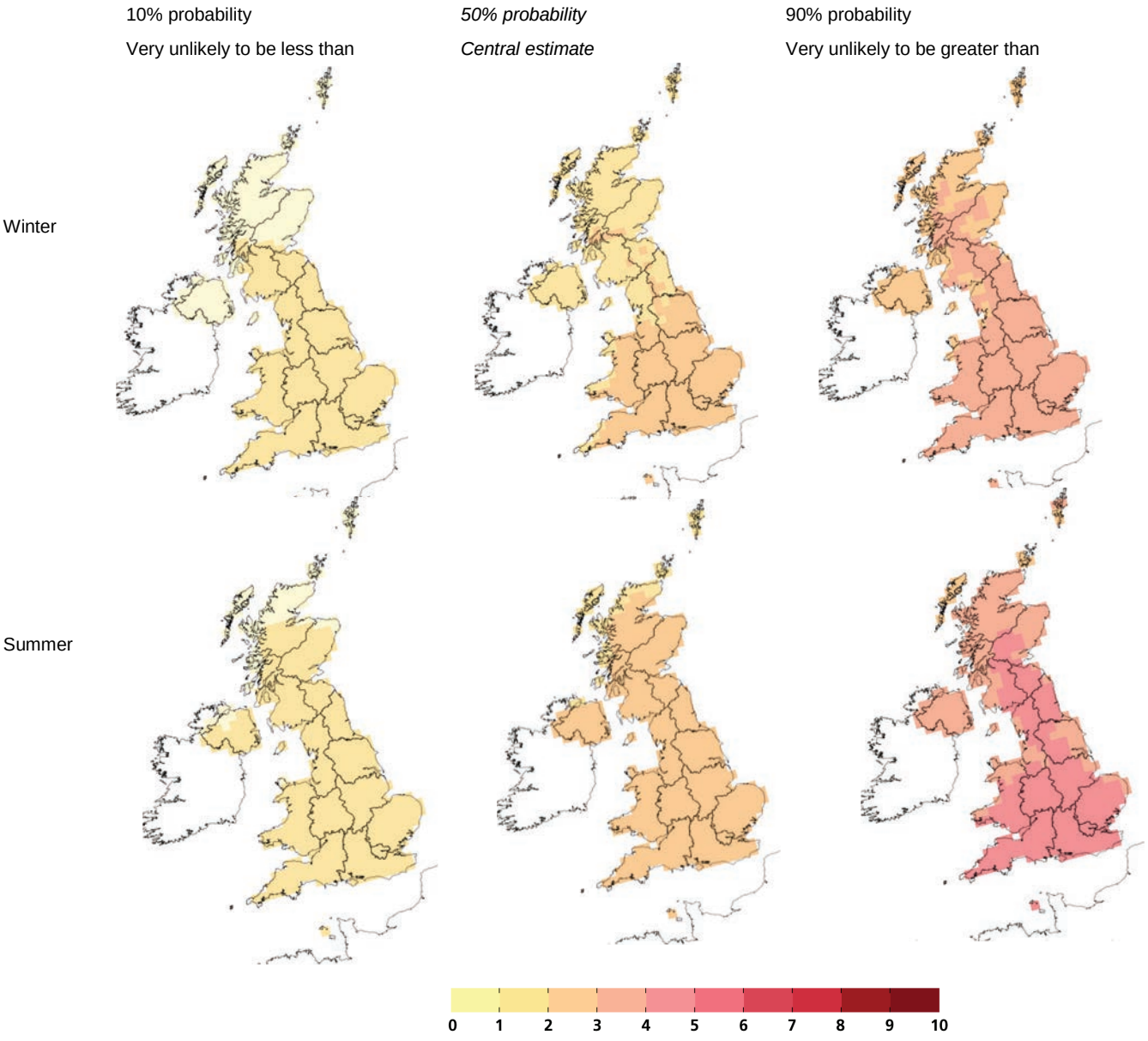
It is anticipated that a new set of climate change projections (UKCP18) will become available in 2018[297].

Figure 9.1, Figure 9.2 and **Table 9.1** present projections for summer and winter temperature and precipitation for the 2050s (2040-2069) by administrative region, as defined in Murphy et al. (2009). Though impractical to reproduce all the relevant figures here, please refer to the UKCP09 technical website[298] for more information.

[297] UK Climate Projections (2016) *UKCP18 Project.* Available online at: http://ukclimateprojections.metoffice.gov.uk/24126

[298] UK Climate Projections (2014) *Maps and key findings*. Available online at: http://ukclimateprojections.defra.gov.uk/21708#key

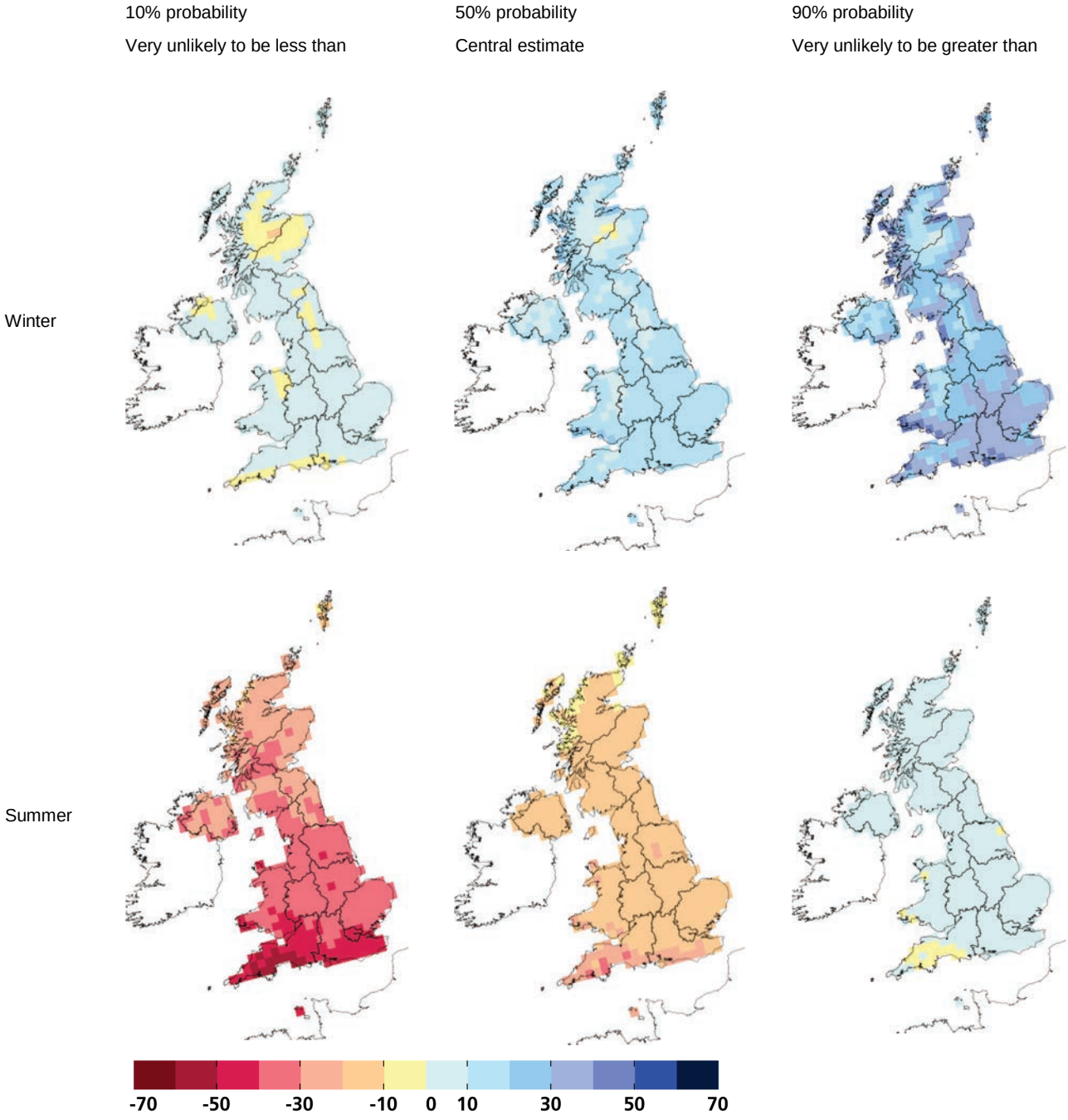
Figure 9.1 Mean Seasonal Probabilistic Temperature Projections for the 2050s, based on the Medium Emissions Scenario



Change in mean temperature (°C).

Source: UK Climate Projections 2009 (Available online at: http://ukclimateprojections-ui.defra.gov.uk/ui/).

Figure 9.2 Mean Seasonal Probabilistic Precipitation Projections for the 2050s, based on the Medium Emissions Scenario



Source: UK Climate Projections 2009 (Available online at: http://ukclimateprojections-ui.defra.gov.uk/ui/).

Table 9.1 Highest and Lowest Changes in Mean Summer and Winter Temperature (°C) and Precipitation (%) by the 2050s, Relative to 1961-1990 for the Medium Emissions Scenario

Variable	Mean Winter Temperature			Mean Summer Temperature			Mean Winter Precipitation			Mean Summer Precipitation		
Probability level (%)	10	50	90	10	50	90	10	50	90	10	50	90
North Scotland	0.6	1.7	2.8	0.9	2	3.4	3	13	24	–23	–10	2
East Scotland	0.7	1.7	2.9	1.1	2.3	3.9	2	10	20	–26	–12	1
West Scotland	1.0	1.9	3.0	1.1	2.4	3.8	5	15	28	–26	–12	1
NE England	1.0	2.0	3.1	1.2	2.5	4.1	1	11	24	–29	–14	1
NW England	1.0	2.0	3.0	1.2	2.6	4.1	3	13	26	–34	–17	1
Yorkshire & Humber	1.1	2.1	3.3	1.1	2.3	3.9	2	11	24	–35	–17	1
East Midlands	1.1	2.2	3.4	1.2	2.5	4.2	2	14	29	–35	–15	6
West Midlands	1.2	2.1	3.2	1.2	2.6	4.4	2	13	28	–36	–16	6
Wales	1.1	2.0	3.1	1.2	2.5	4.1	2	14	30	–36	–16	6
East England	1.1	2.2	3.4	1.2	2.5	4.3	3	14	31	–37	–16	6
London	1.2	2.2	3.5	1.3	2.7	4.6	2	15	33	–39	–18	7
SE England	1.1	2.2	3.4	1.3	2.7	4.6	2	16	36	–40	–18	7
SW England	1.1	2.1	3.2	1.3	2.7	4.6	4	17	38	–41	–19	7

Source: UK Climate Projections 2009 (Available online at: http://ukclimateprojections-ui.defra.gov.uk/ui/).

The nuclear industry continually reviews how best to manage its own operations to adapt to the impacts of climate change, including how to respond to extreme events. In the aftermath of the 2011 Fukushima disaster, operators of all licenced nuclear sites in the UK have carried out safety investigations at their sites to determine their resilience to extreme natural events and are making improvements where necessary[299].

Greenhouse Gas Emissions

The Climate Change Act 2008 was passed in November 2008 and created a new approach to managing and responding to climate change in the UK. This included putting in place legally binding targets with the aim of reducing emissions by at least 80% by 2050 (compared to 1990 levels) and a set of five-year carbon budgets (legally binding limits on the total quantity of greenhouse gas emissions that the country produces over a five year period) to 2022. The UK

[299] Environment Agency 2012: Nuclear Sector Plan, 2012 environmental performance report. Available online at: https://www.gov.uk/government/publications/nuclear-industry-environmental-performance-reports

Government has confirmed its intention within the Fifth Carbon Budget to reduce UK greenhouse gas emissions by 57% by 2030 relative to 1990 levels.

The Carbon Plan: Delivering our Low Carbon Future (2011)[300] explains that if the UK is to cut emissions by 80% by 2050, there will have to be major changes in how energy is generated and used. In particular:

- energy efficiency will have to increase dramatically across all sectors;
- the oil and gas used to drive cars, heat buildings and power industry will, in large part, need to be replaced by electricity, sustainable bioenergy, or hydrogen;
- electricity will need to be decarbonised through renewable and nuclear power, and the use of carbon capture and storage (CCS);
- the electricity grid will be larger and smarter at balancing demand and supply. In the next decade, the UK is expected to complete the installation of proven and cost effective technologies that are worth installing under all future scenarios;
- all cavity walls and lofts in homes, where practicable, are expected to be insulated by 2020;
- the fuel efficiency of internal combustion engine cars will improve dramatically, with CO2 emissions from new cars set to fall by around a third;
- many of our existing coal-fired power stations will close, replaced primarily by gas and renewable;
- more efficient buildings and cars will cut fuel costs; and
- more diverse sources of electricity will improve energy security and reduce exposure to fossil fuel imports and price spikes.

As part of this evolution, under the Renewable Energy Directive (2009/28/EC) the UK is committed to delivering 15% of its energy from renewable sources by 2020.

England

Climate

UKCP09 provides the following changes in climate for England in 2080 based on a medium emission scenario with 90% probability:

- 2080 mean winter temperature: a change in temperature from 4.0ºC in the northwest to 4.7ºC in the south and east of England;
- 2080 mean summer temperature: a change in temperature from 5.4ºC in Yorkshire to 6.5ºC in the south east;
- 2080 mean winter precipitation: increases are in the range 41% in the east midlands to 54% in the south west; and

[300] DECC (2011) *The Carbon Plan: Delivering our low carbon future*. Available online at: https://www.gov.uk/government/publications/the-carbon-plan-reducing-greenhouse-gas-emissions--2

- 2080 mean summer precipitation: no change is expected in Yorkshire to a 7% increase in the south east and London.

Scotland

Climate

UKCP09 provides the following predictions on changes in climate for Scotland in 2080 based on a medium emission scenario with 90% probability:

- 2080 mean winter temperature: a change in temperature from 3.6ºC to 4.0ºC;
- 2080 mean summer temperature: a change in temperature from 4.9ºC to 5.7ºC;
- 2080 mean winter precipitation: increases are in the range 25% to 42%; and
- 2080 mean summer precipitation: increases are in the range 1-4%.

Greenhouse Gas Emissions

The Climate Change (Scotland) Act 2009 sets an interim 42% reduction target for greenhouse gases by 2020, increasing to 80% by 2050 on 1990 levels, whilst associated Orders set out annual targets to ensure steady progress towards the 2050 target. This covers the basket of greenhouse gases recognised by the UNFCCC, and includes Scotland's share of emissions from international aviation and international shipping.

Wales

Climate

UKCP09 provides the following predictions on changes in climate in Wales for 2080 based on medium emission scenario with 90% probability:

- 2080 mean winter temperature: a change in temperature of 4.2ºC;
- 2080 mean summer temperature: a change in temperature of 5.8ºC;
- 2080 mean winter precipitation: increases of 42%; and
- 2080 mean summer precipitation: increases of 5%.

Greenhouse Gas Emissions

Part 2 of the ***Environment (Wales) Act 2016*** establishes a statutory framework for action on climate change, including targets for reducing emissions of greenhouse gasses and associated duties. The Welsh Ministers are required to ensure that the 'net Welsh emissions account' for the year 2050 is at least 80% lower than the baseline, set at 1990 emissions levels, and they must also specify in regulations interim targets for 2020, 2030 and 20240 and set five yearly carbon budgets.

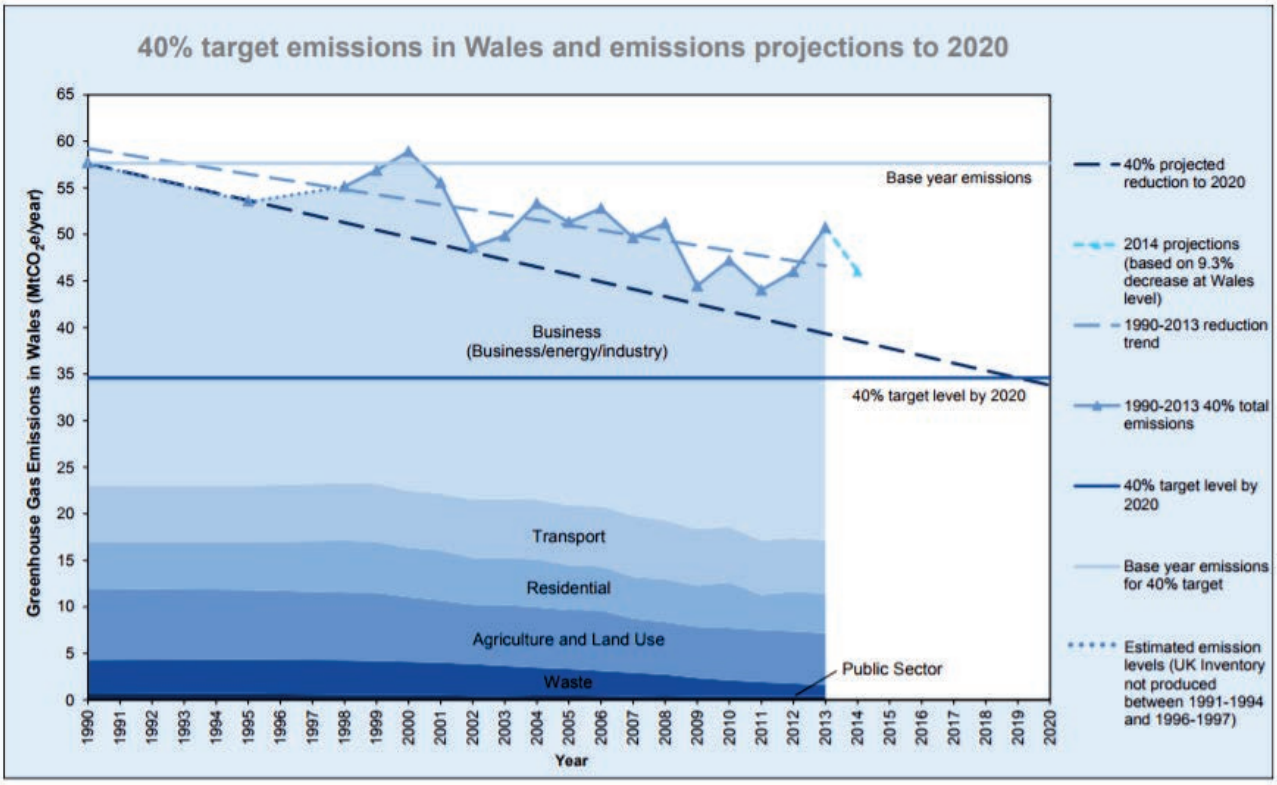
The Welsh Government also intends to achieve at least a 40% reduction by 2020 compared to figures from 1990. This target is measured against a baseline of average emissions between 2006 and 2010. The 3% target includes all 'direct' greenhouse gas emissions in Wales except those from heavy industry and power generation. Those installations are covered by the EU Emissions Trading Scheme (EU ETS). They have set target ranges for the minimum level of emission reduction they would expect to see from each sector by 2020.

- public sector reduced to a maximum of 0.83 MtCO2e, against a baseline of 1.13 MtCO2e;

- business emissions (that fall within Wales' 3% target) reduced to between 8.33 and 10.30 MtCO2e, against a baseline of 11.24 MtCO2e;
- transport emissions reduced to between 5.21 and 5.78 MtCO2e, against a baseline of 7.14 MtCO2e;
- agriculture and land use emissions reduced to between 4.07 and 4.97 MtCO2e, against a baseline of 5.57 MtCO2e;
- residential emissions reduced to between 5.46 and 6.04 MtCO2e, against a baseline of 7.48 MtCO2e; and
- waste emissions reduced to between 0.64 and 0.95 MtCO2e, against a baseline of 1.30 $MtCO_2e$.

Figure 9.3 shows the projected emissions for Wales and progress against the target of a 40% reductions in emissions compared to the 1990 baseline. Whilst anticipating a reduction in emission for future years, the overall trend in the reduction of emissions is not sufficient to meet the 40% target. This is attributed to an increase in emissions from the restart of Tata Steel's Port Talbot No.4 Blast Furnace in February 2013 and a shift from natural gas to coal use in power stations[301]. It should be noted however that Welsh Ministers must set in regulation before the end of 2018 the interim targets (for 2020, 2030 and 2040) and first two carbon budgets covering the periods 2016- 2020 and 2021- 2025 respectively[302], which may further reduce emissions beyond current trends.

Figure 9.3 Emissions projections for Wales



[301] Welsh Government (2016) *Sustainable Development and Climate Change Annual Report*. Available online at: http://gov.wales/docs/desh/publications/160315-sustainable-development-and-climate-change-annual-report-2015-en.pdf
[302] Welsh Government (2017) *Decarbonisation Programme: Newsletter June 2017*. Available online at: http://gov.wales/docs/desh/publications/170531-decarbonisation-programme-newsletter-en.pdf

Assessing Significance

The objectives and guide questions related to climate change which have been identified for use in the appraisal of the effects of Geological Disposal Infrastructure NPS proposals are set out in **Table 9.2**, together with reasons for their selection.

Table 9.2 Approach to Assessing the Effects of the Geological Disposal Infrastructure NPS on Climatic Factors

Objective/Guide Question	Reasoning
Objective: To minimise greenhouse gas emissions as a contribution to climate change and ensure resilience to any consequences of climate change.	The SEA Directive (2001/42/EC) requires that the likely significant effects on the environment, which includes population, human health, climatic factors, material assets and their integration, should be taken into account in the Environmental Report, which for the purposes of the AoS is incorporated within the AoS Report.
Will the Geological Disposal Infrastructure NPS help to ensure a low carbon design solution to the disposal of higher activity radioactive wastes, at both construction and operation phases?	Government legislation (Climate Change Act 2008; Flood & Water Management Act 2010) and strategies seek to address the causes and consequences of climate change, minimising harmful emissions and investing in infrastructure that will help limit the consequences of climate change on life, property and other environmental indicators considered as part of this assessment. Government legislation (under international agreements) commits to the progressive reduction in CO_2 and other greenhouse gas emissions.
Will the Geological Disposal Infrastructure NPS promote climate change adaptation (including rising temperatures and more extreme weather events)?	UKCP09 scenarios show that increasing temperatures and changes to precipitation, increased storminess and extreme weather is expected, which has the potential to impact on the proposals.

Table 9.3 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the climatic factors objective.

Table 9.3 Illustrative Guidance for the Assessment of Significance for Climate Change

Effect	Description	Illustrative Guidance
++	Significant Positive	• Option would help to significantly reduce carbon and other greenhouse gas emissions; • Option would increase resilience/decrease vulnerability to climate change in the wider environment.
+	Positive	• Option would help to reduce carbon and other greenhouse gas emissions; • Option would increase resilience/decrease vulnerability to climate change in the wider environment.
0	Neutral	• Option would not lead to an overall change in carbon and other greenhouse gas emissions in a way that would not contribute to climate change or resilience to climate change within the wider environment.
-	Negative	• Option would increase carbon and other greenhouse gas emissions; • Option would decrease resilience/increase vulnerability to climate change in the wider environment.
--	Significant Negative	• Option would significantly increase carbon and other greenhouse gas emissions; • Option would decrease resilience/increase vulnerability to climate change in the wider environment.
?	Uncertain	• From the level of information available the effect that the option would have on this objective is uncertain.

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 9.4 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria[303]' and 'No NPS' on the climatic factors objective. The appraisal considers in-turn the three sub-sections used for each topic within Chapter 5 (Impacts) of the draft NPS: Applicant's Assessment; Decision Making (subdivided into specific areas of interest) and Mitigation. The performance of the draft NPS and the two reasonable alternatives are scored accordingly, with a commentary provided in the Appraisal column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15 - 20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement.

[303] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-term (less than 20 years), MT – medium-term (between 20 and 170 years) and LT – long-term (>170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

Table 9.4 Appraisal of the Draft NPS and Reasonable Alternatives: Climatic Factors

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	+	+	+/?	**Draft NPS:** The text in the draft NPS under the heading of Applicant's Assessment (paragraphs 5.5.4 and 5.5.5) states that '*Carbon impacts should be considered as part of the appraisal of the development options, prior to the submission of an application for development consent. While it is unlikely that the development of geological disposal facility infrastructure will adversely affect the Government's ability to meet its emissions targets, the applicant should provide evidence of the carbon impact of the development and an assessment of emissions associated with construction against government targets.'* The draft NPS also states that applicants should demonstrate that the development (including both surface and underground facilities) is resilient and adaptable to a changing climate over its operational lifetime. The consideration of the carbon impacts of scheme options and the subsequent assessment of climate change effects will help to ensure that climate change mitigation and adaptation are duly taken into account in the applicant's decision making process, that effects are fully identified and that appropriate mitigation measures are implemented. The applicant should also show that the development is resilient to a changing climate, which may include appropriate mitigation measures, over the lifetime of the proposed development, which should include both surface and underground parts of the development. Long-term climate changes on a geological timescale will be dealt with through the environmental safety case for the facility. The applicant need not present how underground facilities will be robust to these changes in climate during the post-closure phase as this will be part of the environmental safety case and assessment by the EA before granting the environmental permit. Overall, there are likely to be positive effects on climatic factors. *Recommendations for Improvement* The text at paragraph 5.5.4 could usefully refer to the need for applicants to include associated developments when considering the impacts of climate change in the appraisal of scheme options and could also stipulate how applicants must consider the impacts of climate change when planning the location, design, build, operation and decommissioning and final closure of a geological disposal facility. The guidance contained in the draft NPS stipulates that an assessment of carbon impacts, the projected impacts of climate change and resilience to the effects of climate change be included within an application. However, the text could make it more explicit that this information should be included in an ES together with a cross-reference to Section 4.6 of the draft NPS and which provides further detail in respect of climate change adaptation. Paragraph 5.5.5 regarding the evidence of the carbon impact of a development should make reference to emissions during operation and closure (including in respect of associated developments) in addition to construction effects already cited. It would be useful for the text to make direct reference to the Planning Practice Guidance (PPG) on how planning can deal with the uncertainty of climate risks when promoting adaptation in developments (PPG Climate Change, Paragraph: 005

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Reference ID: 6-005-2014-0306). Consideration should also be given to providing further guidance on the possible contents of the ES with regards to climatic factors. The specification of the contents of the ES could be drawn from the following[304]: • Any modelling or detailed quantification of a project's greenhouse gas (GHG) emissions through its construction and operation should be presented, as relevant, within an appendix, which should be cross-referenced from a description of its findings that is contained in the main ES. • If an Energy Statement is required, it should be included within the ES to be considered good practice; as a minimum the ES must effectively summarise and cross reference its findings. • Any mitigation, compensation or monitoring related to a proposed development's GHG emissions (though it's construction and operation) should be included in a draft Environmental Management Plan (EMP), within the ES. If appropriate, the measures should be written to allow the consenting authority to condition the activity specified. • Following approval, GHG emissions should continue to be considered during detailed design, contractor negotiations and construction via the implementation of the EMP. • Additional or new actions that could be taken to minimise emissions should be factored into the project post-consent as appropriate, with the newly operational site considering implementing an Environmental Management System (EMS) to effectively manage its GHG emissions.
				Draft NPS including Exclusionary Criteria: The effects of this reasonable alternative would be similar to those identified in respect of the draft NPS above. However, the setting of clear parameters on siting which excludes landscape, cultural and natural heritage assets could limit areas for development and siting of proposed infrastructure and increase the potential for (particularly associated) development being located in areas subject to, for example, increased flood risk. However, given the requirements of planning policy and the draft NPS this would be unlikely.
				No NPS: DCO applications would be subject to the provisions of national planning policy and EIA Regulations under this alternative. The absence of a clear statement on the full range of information to be submitted with regards to climatic factors in the ES (as proposed in the draft NPS) risks development not effectively mitigating climatic impacts. However, this reasonable alternative would still be considered to have a positive effect against this objective.
Decision Making	**+**	**+**	**+/?**	**Draft NPS:** The draft NPS stipulates that, should the development of geological infrastructure result in an increase in carbon emissions, this will not be considered a reason to refuse development consent unless the resulting increase in carbon emissions is so significant that it would have a material impact on the Government's ability to reach its carbon reduction

[304] IEMA (2010) *Climate Change Mitigation and EIA.* Available online at: https://www.iema.net/assets/templates/documents/climate20change20mitigation20and20eia.pdf

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				targets. The draft NPS requires that when assessing emissions as a result of development, the Secretary of State should take into account that: nuclear power is a low carbon form of electricity generation; Government policy is that, before consent is granted for the development of new nuclear power stations, Government should be satisfied that arrangements exist or will exist to manage and dispose of the waste they produce; and geological disposal infrastructure provides the management and disposal solution and is therefore an enabler of low carbon new nuclear power. The draft NPS sets out that the Secretary of State should refuse development consent if the applicant fails to show that they have considered the impact of climate change over the operation lifetime of the proposed development and not given consideration to the adaptability to a range of potential future climatic environments.
				Draft NPS including Exclusionary Criteria: Setting clear exclusionary criteria for siting is considered unlikely to generate any additional effects beyond those identified above in respect of the draft NPS.
				No NPS: Under this alternative, DCO applications will be subject to the provisions of national planning policy and the EIA Regulations which would be considered to have a positive, albeit uncertain, effect against this objective. The uncertain effect arises from the absence of a clear statement on the role of the Secretary of State when assessing carbon emissions and adaptability to the impacts of climate change and reasons for refusing development consent if the applicant has failed to show that they have considered the impact of climate change over the lifetime of a proposed development (as proposed in the draft NPS).
Mitigation	**+**	**+**	**+/?**	**Draft NPS:** The proposed mitigation measures contained in the draft NPS include minimising the carbon footprint of geological disposal infrastructure so as to mitigate its contribution to climate change. The draft NPS stipulates that the design of the facility, including configuration and layout and use of materials, should be considered in terms of the carbon emissions impact (within safety and operational constraints). It also states that the Secretary of State will consider the effectiveness of such mitigation measures in order to ensure that the carbon footprint is as low as reasonably practicable, in relation to design and construction. The Secretary of State's view of the adequacy of the mitigation measures relating to design and construction will be a material factor in the decision making process (paragraph 5.5.11). This has been assessed as having a positive effect on this objective, although it is noted that no mitigation measures are identified in this section of the draft NPS relating to climate change adaptation.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Recommendations for Improvement The mitigation measures identified in the draft NPS could be revised to be more specific and clearly reflect the potential effects associated with the key project stages of site investigation, construction, operation and closure, as summarised below[305]. *Site Investigation* Adverse effects on climatic factors during the siting process will be apparent in a broad range of activities and the use of materials with embodied energy are likely to give rise to direct and indirect carbon emissions during the borehole drilling programme. The Radioactive Waste Management Ltd (2016) Geological Disposal Generic Environmental Assessment (GEA) report (based on a carbon footprint study[306] of quantified carbon emissions) that the construction and operation of the deep boreholes is estimated to generate in the region of 5,850 tonnes of CO_2e in total (irrespective or rock type). The major contributions to the footprint are: the creation of access roads to the borehole drilling pads; operation of static and mobile rigs/forklift trucks; and operation of offices and other facilities. However, the GEA report highlights that in comparison with UK per-capita CO_2 emissions, effects would be negligible. Consideration could be given to the inclusion of the following mitigation measures: • Full consideration of climate change issues in the siting process. • Seek to minimise embodied energy/carbon in construction materials. • Design and locate site offices to maximise energy efficiency. • Incorporate energy efficiency/ emission reduction measures in environmental management plans (EMPs). • Maximise use of renewable energy sources, including alternative fuel sources for site based equipment. • Consider opportunities to minimise CO_2 emissions associated with staff travel, including provision of alternative modes of transport. The GEA report highlights that opportunities may exist to increase the proportion of energy generated from renewable sources for operations associated with the siting process. Opportunities may also exist to increase the proportion of energy generated from renewable sources locally through community investment. *Construction* Adverse effects during the construction phase will reflect the direct or indirect combustion of fossil fuel from construction traffic/vehicle movements and plant, generators and the embodied energy within construction materials used. The largest

[305] Derived from: Radioactive Waste Management Ltd (December 2016) *Geological Disposal Generic Environmental Assessment*
[306] Radioactive Waste Management Ltd (December 2016) *Geological Disposal Generic Carbon Footprint Analysis*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				contributor to carbon emissions during the construction phase would be the construction of the underground facilities, including the excavation of tunnels and vaults, removal of rock via HGVs etc., and use of shotcrete/cement etc. The 2016 carbon footprint study has quantified carbon emissions from all construction activities at around 0.63 million tonnes of CO_2e for a higher strength rock site, around 1.4 million for lower strength rock and around 0.48 million tonnes for evaporite rock. The number of disposal vaults and tunnels proposed for each rock type, and the associated design differences, are the main factors influencing the difference in estimated carbon emissions. This includes estimated larger quantities of excavated rock spoil likely in the case of the lower strength and evaporite rock types. In both the higher and lower strength sedimentary rock environments, the amount of embodied carbon associated with construction, backfill and buffer materials is higher than that associated with an evaporite environment. During construction, this is due to the differences in volumes of concrete and shotcrete used. The 2016 carbon footprint study has compared the estimated carbon emissions arising from construction with other large infrastructure projects. This concludes that the other projects generally have a lower proportion of embodied carbon than that estimated for a GDF. Otherwise, given the relative scale and nature of the projects, emissions are broadly comparable. It is also important to set the carbon emissions associated with a GDF within the context of the contribution nuclear generation makes towards low carbon energy generation and the wider framework of UK Government commitments towards reduced CO_2 emissions. A GDF would be an essential part of the plan for the continuation of nuclear electricity generation in the UK and by providing a management and disposal solution for associated radioactive waste, it would be an enabler of low carbon energy generation. Potential effects that may arise from climate change could include flood risk on construction activities. The developer of a GDF would need to demonstrate to the independent nuclear regulators that the site of a GDF was adequately protected from external hazards arising from natural processes taking account of the potential effects of climate change, such as extreme weather events. If set within a coastal setting, the issues which would need to be considered could also include storm surges, sea level rise and coastal erosion. However, the likelihood of any effect on a GDF is considered to very low. In addition to the continuation of the above mitigation measures, additional mitigation measures during construction could include: • Consider climate change issues, including resilience to change, adaptability and climate-change effects, in the construction-phase EMP. • Use/specify materials with high recycled content and inherently low embodied carbon content, for example use of a percentage of pulverised fly ash or ground granulated blast-furnace slag for concrete/shotcrete, and recycled steelwork. • Minimise distances for transporting construction materials to site, through specification of local sources where feasible. • Minimise distance for offsite spoil disposal.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• Consider opportunities to minimise CO_2 emissions associated with staff travel, including provision of alternative modes of transport (alternatives to car travel, such as provision of staff park and ride facility or measures to encourage cycling) and/or site based worker accommodation. *Operation* During the operational stage of development, surface construction would cease but underground excavation/construction would continue to contribute to climate change. Overall, construction of the disposal vaults is considered to be by far the largest contributor of carbon emissions over the whole lifetime of a GDF as construction of the vaults will begin during the construction phase but will extend through the lifetime of a GDF with new vaults created on a needs basis. Emissions associated with this activity have already been included in the figures set out above for construction. The means by which radioactive waste is transported to the facility will be key to the operation footprint, independent of rock type. The 2016 carbon footprint study quantifies carbon emissions in the operational phase for two different transport scenarios. It has estimated around 1.5 million tonnes of CO_2 for all rock types, when transporting waste packages by road and rail, and around 1.4 million tonnes when transporting waste packages by sea, road and rail. As per the construction phase, the developer of a GDF would need to demonstrate to the independent nuclear regulators that the site of a GDF was adequately protected from external hazards arising from natural process taking account of the potential effects of climate change. In addition to the continuation of the above mitigation measures, additional mitigation measures during operation could include: • Environmental management regarding climate change adaptability and resilience throughout operational period. • Periodic review of the effectiveness of the resilience measures. • Periodic review and updating of EMPs. • Appropriate response to change as observed. • Consider alternative transport modes for radioactive waste and minimise distance travelled to/from site. *Closure* During the closure phase, the excavation of disposal vaults and emplacement of radioactive waste would cease and the principal activities would be backfilling the remaining underground facilities, including the access shafts and drift, decommissioning of the surface facilities and site restoration (dependent on the end state agreed with the local community). The 2016 carbon footprint study quantifies CO_2 emissions in this phase at around 5.2 million tonnes for higher strength rock, around 2.3 million tonnes for lower strength sedimentary rock and around 70,000 tonnes for evaporite rock. Following closure, the potential climate change effects described above at the surface would no longer have any effect on the GDF. The safety case for the facility would, however, be expected to demonstrate that the facility would remain safe in light of the potential longer term climate trends such as sea level rise and glacial cycles. In addition to the continuation of the above mitigation measures, additional measures during closure could include: • Full consideration of climate change issues in the decision making process for the end state of the GDF site.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• Use/specify materials with high recycled content and inherently low embodied carbon content for backfill and buffer materials, where feasible. • Minimise additional import of materials for buffer/backfill, and consider alternative modes of transport for imported materials required.
				Draft NPS including Exclusionary Criteria: The specification of exclusionary criteria is unlikely to make a difference to the application of the mitigation and enhancement measures as set out for the draft NPS above. In consequence, the predicted effects are likely to be similar.
				No NPS: Appropriate mitigation measures will be considered by the relevant authority in light of the proposals submitted. As such, mitigation measures will be forthcoming but there is the risk that they are not comprehensive or consistent (without the direction and guidance given in the draft NPS) and so will not fully address any effects arising or is accompanied by greater uncertainty.
Other Sections of the Draft NPS Relevant to Climatic Factors	**1. Introduction** 1.1.3 There is an opportunity for the consideration of effects on climatic factors in a specific locality through the preparation of a local impact report submitted by a local authority in accordance with the Planning Act. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on climatic factors as an issue, helping to ensure that consideration is given to likely effects in a particular locality. 1.1.5 Consideration of the effects on climatic factors is reflected in the need to apply the draft NPS in the context balancing adverse impacts and benefits. The net result of this balancing exercise could be uncertain, however. 1.1.7 The generic impacts considered in the draft NPS, along with the application of the draft NPS as a material consideration on a case by case basis, could result in uncertainty over what provisions will be applied in respect of the consideration of climatic factors and the mitigation of adverse effects. **1.4 Consideration of deep boreholes investigations** – the role and content of an ES, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of climatic factors, providing appropriate mitigation measures where appropriate. **1.5 Consideration of geological disposal facilities** - due to the long-term nature of a GDF, the applicant should take into consideration the need to retain the opportunity to maintain or upgrade infrastructure surrounding the facility over the lifetime of the proposed development. For example, the surface facility must be resilient to the variability in climate over the operational lifetime of the facility, and be able to operate efficiently as transport systems evolve over the lifetime of the proposed development. **2. Government Policy on Management of Higher Activity Radioactive Waste** 2.2.6. The preference for disposal through a single site will mean that climatic factors impacts would potentially be greater in a single location. 2.4.3 The technical strategy for implementation provides for the opportunity to consider climatic factors as the process proceeds iteratively in tandem with the siting process. **3. The Need for Geological Disposal Infrastructure** 3.2.16 Section 5(8) of the Planning Act requires that the policy set out in the NPS takes account of Government policy relating to the mitigation of, and adaptation to, climate			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	change, including climatic factors. 3.2.17 For the UK to meet its energy and climate change objectives, the Government considers that there is an urgent need for new electricity generation, including new nuclear power. 3.2.16 Before development consents for new nuclear power stations are granted, the Government will need to be satisfied that effective arrangements exist or will exist to manage and dispose of the waste that they will produce. In 2011, the Government set out in the National Policy Statement for Nuclear Power Generation why it was satisfied that such arrangements will exist. The Government considered these conclusions in the production of the 2014 White Paper and was satisfied that they still applied. **4. Assessment Principles** **4.1 General principles of assessment** – the scale of development proposed by a GDF could lead to significant impacts on the environment, the economy and communities. The provisions of the Planning Act and the policies and protections set out in the draft NPS provide for a balanced consideration of impacts and benefits. The requirement for the identification of positive and adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for consideration of climatic factors. This section also provides detail on the principles against which the application should be judged in relation to design, the environment, health, safety and security aspects, as noted in Table 1 of the draft NPS. **4.2 Environmental Impact Assessment**– the consideration of proposals within the EIA Regulations and the preparation of an ES (where required) agreed by statutory agencies and specifying mitigation and enhancement measures will ensure that climatic factors are fully considered, as will the consideration of cumulative effects and interrelationships between effects. **4.3 Habitats Regulations Assessment** – no direct relationship identified. **4.4 Alternatives** – the identification that reasonable alternatives will be required as part of scheme design and project planning should ensure that climatic factors are taken into account, both in terms of identifying any opportunities for mitigation and enhancement. **4.5 Criteria for 'good design for geological disposal infrastructure** – applying 'good design' to geological disposal infrastructure will support the development of sustainable infrastructure which is efficient in the use of natural resources and energy and which should have a positive effect upon minimising emissions and promoting climate change resilience. Similarly, the Planning Act gives importance to sustainability and the Secretary of State needs to be satisfied that development adheres to the principals of sustainable development. **4.6 Climate Change Adaptation** – the Planning Act requires the Secretary of State to have regard to the desirability of mitigating, and adapting to, climate change in designating and reviewing an NPS. The Secretary of State should also take the effects of climate change into account when consenting geological disposal infrastructure. Adaptation of development is necessary to deal with the potential impacts of climate change over the operational lifetime of the GDF. Applicants must consider the impacts of climate change when planning the location, design, build, operation and decommissioning and final closure of a GDF. The ES should set out how the proposal will take account of the projected impacts of climate change. When preparing the ES, applicants should apply, as a minimum, the emissions scenario that the Independent Committee on Climate Change suggests the world is currently most closely following – and the 10%, 50% and 90% probability level ranges. The applicant should also apply the CO2 high emissions scenario (high impact, low likelihood) to those elements critical to the safe operation of the infrastructure. The ES should set out how the proposal will take account of the projected impacts of climate change. The Secretary of State must be satisfied that there are no features of the design of any geological disposal infrastructure, critical to its safe operation, which may be seriously affected by more radical changes to the climate beyond that projected. Where adaptation measures are necessary to deal with the impact of climate change, and those measures would have an adverse effect on other aspects of the project and/or surrounding environment, the Secretary of State may require the applicant to implement adaptation measures should the need arise, rather than at the outset of development. **4.7 Pollution Control and other Environmental Regulatory Regimes** – no direct relationship. **4.8 Common Law Nuisance and Statutory Nuisance** – no direct relationship identified. **4.9 Safety** – no direct relationship identified. However, the impacts of climate change will be an important consideration in determining the safety of a scheme.			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	4.10 Health –where the proposed development has an effect on human beings, the ES should assess these effects for each element of the project, including climatic factors, identifying any adverse health impacts and mitigation measures to avoid, reduce or compensate for such impacts as appropriate. **4.11 Security Considerations** – no direct relationship identified. **Section 5 (other topics)** – it should be noted that there are links between climatic factors and the other topics contained in Section 5 of the draft NPS including, in particular, those related to water quality, flood risk and coastal change and biodiversity and nature conservation. Taken together, it is anticipated that these topics will generate further positive effects in respect of climatic factors.			
Summary Appraisal of Likely Significant Effects	+	+	+/?	**Draft NPS:** The construction, operation and closure of geological disposal infrastructure will contribute to climate change due to emissions associated with, for example, vehicles movements to and from site (including road and rail), the use of powered plant, the embodied carbon within the construction materials and carbon emissions associated with energy use. The draft NPS seeks to ensure that the carbon impacts of development, including materials used in the construction of the facility and operational procedures, are assessed and appropriate mitigation measures implemented so as to reduce carbon emissions. The Secretary of State should refuse consent if the applicant has failed to show they have considered the impact of climate change over the lifetime of operation. Mitigation measures, where required, are focused around minimising the carbon footprint of development. The adequacy of the mitigation measures relating to design and construction will be a material factor in the decision making process for the Secretary of State. The draft NPS seeks to minimise the carbon footprint of development as a contribution to climate change and ensure resilience to any consequences of climate change. In consequence, the draft NPS should help to ensure a low carbon design solution to the disposal of higher activity radioactive wastes during the siting, construction, operation and closure phases. The draft NPS also promotes climate change adaptation as part of the design of the development, including rising temperatures and more extreme weather events, and design and construction are a material consideration as part of the decision making process for the Secretary of State. This, alongside other requirements set out in the draft NPS, could help to minimise direct effects with respect to climatic factors. By helping to ensure that long-term provision is made for the management of waste in the inventory for disposal, the draft NPS will indirectly contribute to greater certainty and the management of risks to support the future nuclear energy industry and the generation of low carbon electricity. Overall, the implementation of the draft NPS is likely to result in a positive effect in respect of minimising carbon impacts and promoting climate change adaptation.
				Draft NPS including Exclusionary Criteria: Positive effects on climatic factors associated with this reasonable alternative are expected to be broadly similar to those identified in respect of the draft NPS above. The setting of clear parameters on siting which excludes landscape, cultural and natural heritage assets could limit areas for development and increase the potential for (particularly associated) development being located in areas subject to, for example, flood risk. However, given the requirements of planning policy and the draft NPS, this would be unlikely.
				No NPS: Despite the absence of a guiding framework on climatic factors, this reasonable alternative is likely to result in positive effects overall as any development would be subject to the provisions of national planning policy and the EIA

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Regulations. However, the absence of a clear statement on the full range of information to be submitted in the ES and considered by the Secretary of State risks development not effectively mitigating carbon emissions and proposing effective adaptation. It is acknowledged that whilst mitigation measures would be forthcoming under this alternative, there is a risk that these are open to interpretation and that they may not fully address an appropriate range of activities.
Summary of Recommending Mitigation and Enhancement	Although the draft NPS is considered to have a positive effect in terms of minimising the carbon footprint of development and climate change adaptation, the appraisal identifies a number of recommended mitigation and enhancement measures that could be applied. In particular, the guidance contained in Section 5.5 of the draft NPS could make explicit reference to the inclusion of a carbon impacts assessment within an ES. This text could also stipulate how applicants must consider the impacts of climate change when designing a geological disposal facility and associated infrastructure. It is suggested that the draft NPS makes direct reference to Planning Practice Guidance with regards to climate change and provides further guidance on the contents of the ES. Additional mitigation measures could be included within the draft NPS including the use of EMPs and management and monitoring of development. This, alongside other requirements set out in the draft NPS, could help to minimise direct effects with respect to climate change mitigation and adaptation.			

10. Waste and Resource Use

Introduction

This section presents the overview of plans, programmes and baseline information for the detailed appraisal of the sustainability of the National Policy Statement for Geological Disposal Infrastructure in respect of waste and resource use.

Waste management in this context is defined as the processing, recycling or disposal of a range of waste types including municipal, commercial and industrial, construction, excavation and demolition and hazardous wastes. However, it is important to note that consideration of the management of waste links to a number of other Appraisal of Sustainability (AoS) topics, the most relevant being climate change given the potential for waste to be recovered for energy use. Resource use, meanwhile, primarily relates to minerals and raw materials with the use of water resources, soils and energy captured under the water quality, land use, geology and soils and climatic factors AoS topics.

Review of Plans and Programmes

The review of plans and programmes related to waste has identified two key objectives, firstly the need to minimise and manage waste in accordance with the waste management hierarchy and secondly the suitable disposal of hazardous wastes. The need to minimise and manage waste affects all industries. The focus of the NPS is on ensuring the safe management of radioactive waste in the long term.

International/European

At the international level, the ***Basel Convention*** entered into force in 1992 and is a global agreement, ratified by several member countries and the European Union, for addressing the problems and challenges posed by hazardous waste. The key objectives of the Basel Convention are:

- to minimise the generation of hazardous wastes in terms of quantity and hazardousness;
- to dispose of them as close to the source of generation as possible; and
- to reduce the movement of hazardous wastes.

The ***World Summit on Sustainable Development (2002)*** in Johannesburg proposed broad-scale principles which should underlie sustainable development and growth, including an objective on greater resource efficiency.

The International Atomic Energy Agency (IAEA) ***Convention on Nuclear Safety (1994)*** aims to legally commit participating States operating land based nuclear power stations to maintain a high level of safety by setting international benchmarks. The IAEA's ***Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*** (1997) meanwhile, was the first legal instrument aimed to address issues of safely managing spent fuel and radioactive waste on a global scale. The objectives of the Joint Convention are:

- To achieve and maintain a high level of safety worldwide in spent fuel and radioactive waste management;
- To ensure there are effective defences against potential hazards so that individuals, society and the environment are protected now and in the future;
- To prevent accidents with radiological consequences and to mitigate their consequences should they occur.

Initially created to coordinate the Member States' research programmes for the peaceful use of nuclear energy, the ***Euratom Treaty (1957)*** today helps to pool knowledge, infrastructure and funding of nuclear energy. It ensures the security of nuclear fuel supply within the framework of a centralised monitoring system.

At the European Level, the ***Waste Framework Directive (2008/98/EC)*** provides an overarching framework of waste management requirements and sets the basic waste management definitions for the EU. This Directive repealed Directive 2006/12/EC on waste (the codified version of Directive 75/442/EEC as amended), the Hazardous Waste Directive 91/689/EEC, and the Waste Oils Directive 75/439/EEC. The revised Waste Framework Directive includes waste disposal and the protection of the environment from harmful effects caused by the collection, transport, treatment, storage and tipping of waste. It aims to encourage the recovery and use of waste in order to conserve natural resources. The key principles of the Directive include the 'Waste Management Hierarchy' which provides an environmental priority order for waste management options which are: prevention; preparing for re-use; recycling; other recovery (e.g. energy recovery); and disposal. Key objectives are to reduce the adverse impacts of the generation of waste and the overall impacts of resource use. This should be done through a variety of mechanisms, including:

- by 2020, requiring Member States to re-use and recycle 50% of their household waste (by weight) and to reuse, recycle and recover 70% of their non-hazardous construction and demolition waste (by weight);
- applying the waste hierarchy - promoting waste minimisation followed by reuse and recycling, other recovery (such as energy recovery) and disposal - as a priority order in waste prevention and management legislation and policy;
- taking measures as appropriate to promote the re-use of products and preparing for re-use activities; and
- extending the self-sufficiency and proximity principles to apply to installations for recovery of mixed municipal waste from households.

Hazardous wastes pose more of a threat to human health and the environment than do non-hazardous wastes, and consequently require more stringent controls. These are set out in particular in Articles 17 to 20 of Directive 2008/98/EC. It provides additional labelling, record keeping, monitoring and control obligations from the "cradle to the grave", i.e., from the waste producer to the final disposal or recovery. In addition, mixing of hazardous substances is banned in order to prevent threats to the environment and human health. Also, the permit exemptions that may be granted to installations dealing with hazardous wastes are more restrictive than for installations dealing with other wastes.

The approach to classifying hazardous and non-hazardous waste hinge on the system for the classification and labelling of dangerous substances and preparations, which ensures the application of similar principles over their whole life cycle. The properties which render waste hazardous are laid down in Annex III of Directive 2008/98/EC and are further specified by

European Commission Decision 2000/532/EC, which establishes a List of Wastes, as last amended by European Commission Decision 2001/573/EC. A review of the List of Wastes has recently been completed and guidance on the classification and assessment of waste has been published by the UK environment agencies[307].

In this context, the ***Landfill Directive (1999/31/EC)*** focuses on waste minimisation and increasing levels of recycling and recovery. The overall aim of the Directive is to prevent, or reduce as far as possible, negative effects on the environment (in particular the pollution of surface water, groundwater, soil and air and on the global environment, including the greenhouse effect) as well as any resulting risk to human health from the landfilling of waste, during the whole lifecycle of the landfill. The Directive sets the target of reducing biodegradable municipal waste landfilled to 35% of that produced in 1995 by 2020.

There are a number of ***Producer Responsibility Directives*** relating specifically to consumer products. Their purpose is to require businesses to reuse, recover and recycle waste which comes from products they produce, and each Directive sets national targets for recovery and recycling of these wastes.

The ***Mining Waste Directive (2006/21/EC)*** aims to prevent or reduce as far as possible the adverse effects on the environment and any resultant risks to human health from the management of waste from the extractive industries (e.g. mining). The Directive sets out how to achieve this aim by providing for measures, procedures and guidance on how extractive industries should be managed.

The ***Industrial Emissions Directive*** (***2010/75/EU***) is the main EU instrument regulating pollutant emissions from industrial installations. The Directive prescribes emission limit values for certain industrial processes/plants including waste incineration, requires other emissions limit values to be based on Best Available Techniques (BAT), and introduces detailed technical and consultation requirements for permitting processes.

In relation to the management of radioactive materials, the ***Shipments of Radioactive Waste and Spent Fuel Directive (2006/117/Euratom)*** establishes a system of control and prior authorisation for shipments of radioactive materials, including waste, to protect the health of workers and the general public and to avoid illicit traffic of such materials. Specifically in relation to radioactive waste, the ***Spent Fuel and Radioactive Waste Directive (2011/70/Euratom)*** establishes a Community framework for the responsible and safe management of spent fuel and radioactive waste. The Directive requires national policies on radioactive waste and spent fuel to be based on the following principles:

- the amounts generated must be kept as low as possible;
- all steps in generation and management are interdependent;
- safety as a priority;
- generators must bear the full cost of all safety requirements; and
- all decision-making processes must be documented.

Under Council Directive 2011/70/Euratom, each Member State is responsible for managing its own radioactive waste and spent fuel and must implement a national legislative, regulatory and

[307] Natural Resources Wales, SEPA, NIEA, Environment Agency (2015) *Guidance on the classification and assessment of waste (1st edition 2015) Technical Guidance WM3*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427077/LIT_10121.pdf

organisational framework for such material from waste generation through to disposal. Radioactive waste must be disposed of in the country where it was generated, unless there are agreements with other countries. If waste is shipped to a country other than a Member State, responsibility for safety still rests with the Member State that generated it. Also of relevance is ***Council Directive 2003/122/Euratom*** on the control of high-activity sealed radioactive sources and orphan sources (HASS). This Directive aims to prevent exposure to ionising radiation arising from inadequate control of high-activity sealed radioactive sources and to harmonise controls in Member States.

In addition to the above Directives a number of European level policy publications are also of relevance. In relation to general waste minimisation and management issues, the ***European Sustainable Development Strategy (2006)*** and the subsequent ***Review of the EU Sustainable Development Strategy (2009)*** identifies sustainable consumption and production as one of seven key challenges and cross-cutting themes, whilst the European Commission's ***Closing the loop - An EU Action Plan for the Circular Economy*** (2015) seeks to implement the Commission's long-term vision of significantly reducing waste landfilling and increasing recycling.

UK

In terms of relevant UK statutory provisions, the ***Radioactive Substances Act 1993*** prescribed how radioactive substances, including non-nuclear waste, must be handled. However, in April 2010, the Act was repealed in respect of England and Wales and the provisions included in schedule 23 of the ***Environmental Permitting (England and Wales) Regulations 2010*** (SI 2010/675) which brought radioactive substance regulation in to the Environmental Permitting regime. The ***High Activity Sealed Radioactive Sources and Orphan Sources Regulations 2005*** (SI 2005/2686) specify how high-activity sealed radioactive sources should be registered, kept, used or disposed of. These Regulations were also repealed in respect of England and Wales by the Environmental Permitting (England and Wales) Regulations 2010 (with the equivalent provisions included in schedule 23). The ***Ionising Radiations Regulations 1999*** (SI 1999/3232) require employers to protect employees and other people against ionising radiation arising from work with radioactive substances and other sources of ionising radiation.

The ***Strategy for the management of Naturally Occurring Radioactive Material (NORM) in the UK (July 2014)*** aims to facilitate the sustainable and efficient management of Low Level Radioactive Waste in line with the 'waste hierarchy' principle. Similarly, the ***UK Strategy for Radioactive Discharges (July 2009)*** describes how the UK will continue to implement the agreements reached at the 1998 OSPAR (Oslo and Paris Convention on the Protection of the Marine Environment of the North East Atlantic) Ministerial meeting, and subsequent OSPAR meetings on radioactive substances.

Published by the Nuclear Decommissioning Authority (NDA) on behalf of the UK Government in February 2016, the revised ***United Kingdom Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry*** provides a framework for continued capability and capacity for the safe, secure and environmentally responsible management and disposal of LLW in the UK. The document updates the original strategy (2010) to respond to changes which have occurred in the intervening period, including:

- the diversion of significant volumes of LLW from the Low Level Waste Repository (LLWR);
- the development and use of alternate treatment and disposal routes;

- the application of the waste hierarchy by waste producers when making waste management decisions;
- the identification of opportunities for improvement and the sharing of good practices for LLW management;
- the engagement of a broad group of stakeholders within the process.

Despite these changes, the revised Strategy notes that the three strategic themes set out in the original strategy remain relevant and unchanged:

- the application of the waste hierarchy;
- the best use of existing LLW management assets;
- the need for new fit-for-purpose waste management routes.

The UK Government's ***Implementing Geological Disposal White Paper*** (2014)[308] provides a Framework for the long-term management of higher activity radioactive waste. This White Paper updates (and replaces in England and Northern Ireland) a 2008 White Paper by the UK Government and the devolved administrations of Wales and Northern Ireland entitled ***Managing Radioactive Waste Safely – A Framework for Implementing Geological Disposal***. The new White Paper provides information regarding the rationale for pursuing a geological disposal approach through the development of a Geological Disposal Facility (GDF), outlines the applicable policy framework and sets out the UK Government's proposed approach to siting, constructing and operating a GDF. It includes a number of initial actions that will be undertaken by the UK Government and by the developer to help implement geological disposal.

England

The revised Waste Framework Directive has been implemented by the ***Waste (England and Wales) Regulations 2011*** (SI 2011/988), which sets out the main statutory provisions of relevance. This has been amended by the ***Waste (England and Wales) (Amendment) Regulations 2012*** and the ***Waste (England and Wales) (Amendment) Regulations 2014.***

In June 2011Defra published a ***Government Review of Waste Policy in England***, which looked at the most effective ways of reducing waste, maximising the money to be made from waste and recycling and considering how waste policies affect local communities and individual households. The report set out a number of 'Principal Commitments' that aim to achieve a more sustainable approach to the use of materials, deliver environmental benefits and support economic growth. These include:

- promoting resource efficient product design and manufacture and target those waste streams with high carbon impacts, both in terms of embedded carbon (food, metals, plastics, textiles) and direct emissions from landfill (food, paper and card, textiles, wood);
- promoting the use of life cycle thinking in all waste policy and waste management decisions and the reporting of waste management in carbon terms, as an alternative to weight-based measures;

[308] DECC (2014) *Implementing Geological Disposal*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/332890/GDF_White_Paper_FINAL.pdf

- developing a comprehensive Waste Prevention Programme and in the meantime working with businesses and other organisations across supply chains on a range of measures designed to drive waste reduction and re-use as part of a broader resource efficiency programme; and
- continuing to help local communities develop fit for purpose local solutions for collecting and dealing with household waste and working with councils to meet households' reasonable expectations for weekly collections, particularly of odorous waste.

In December 2013, the ***Waste Management Plan for England (WMPE)*** was released by Defra, replacing the National Waste Strategy 2007. It meets the requirements of the revised Waste Framework Directive by bringing together existing plans, policies and legislation under one umbrella. The WMPE does not set new policies or targets but refers to those from the revised Waste Framework Directive that are transposed into the ***Waste (England and Wales) Regulations 2011*** (SI 2011/988). It evaluates how it will support implementation of the objectives and provisions of the revised Waste Framework Directive, and fulfils Article 28 mandatory requirements which specify that the Plan should contain the following information:

- an analysis of the current waste management situation in the geographical entity concerned, as well as the measures to be taken to improve environmentally sound preparing for re-use, recycling, recovery and disposal of waste and an evaluation of how the Plan will support the implementation of the objectives and provisions of the revised Waste Framework Directive;
- the type, quantity and source of waste generated within the territory, the waste likely to be shipped from or to the national territory, and an evaluation of the development of waste streams in the future;
- existing waste collection schemes and major disposal and recovery installations, including any special arrangements for waste oils, hazardous waste or waste streams addressed by specific Community legislation;
- an assessment of the need for new collection schemes, the closure of existing waste installations, additional waste installation infrastructure in accordance with Article 16 (on the proximity principle), and, if necessary, the investments related thereto;
- sufficient information on the location criteria for site identification and on the capacity of future disposal or major recovery installations, if necessary; and
- general waste management policies, including planned waste management technologies and methods, or policies for waste posing specific management problems.

The ***Waste Prevention Programme for England (December 2013)*** sets out the roles and actions that government, businesses, the wider public sector and civil society must play, to reduce the amount of waste produced in England.

The ***National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2012)*** sets out the Government's expectation for local planning authorities to set out the strategic priorities for their area in the local plan and include strategic policies to deliver the provision of infrastructure for waste management and the provision of minerals. In doing so, they should work with other relevant organisations and providers to assess the quality and capacity of infrastructure for waste and its ability to meet forecast demands.

Minerals planning authorities are expected to develop and maintain an understanding of the mineral resource (of both local and national importance) in their areas and assess the projected demand for their use, taking full account of opportunities to use materials from secondary and other sources which could provide suitable alternatives to primary materials. The NPPF defines 'minerals of local and national importance' as minerals which are necessary to meet society's needs, including aggregates, brick, clay, silica sand, cement raw materials, gypsum, salt, fluorspar, coal, oil and gas (including hydrocarbons) tungsten, kaolin, ball clay, potash and local minerals of importance to heritage assets and local distinctiveness.

In order to facilitate the sustainable use of minerals, the NPPF sets out a number of expectations relating to specific minerals for local authority plan-making and decisions on planning applications. In doing so, the Framework includes safeguards so as to ensure permitted operations do not have unacceptable adverse impacts on the natural and historic environment or human health.

National Planning Policy for Waste (October 2014) sets out detailed waste planning policies and is intended to be read in conjunction with the National Planning Policy Framework, the Waste Management Plan for England and National Policy Statements for Waste Water and Hazardous Waste.

Planning Practice Guidance (October 2014) provides guidance on the planning for mineral extraction in plan making and the application process, as well as further information in support of the implementation of waste planning policy.

Hazardous waste in England is addressed by the Hazardous Waste (England and Wales) Regulations 2005 as amended by The Hazardous Waste (England and Wales) (Amendment) Regulations 2009 and the Hazardous Waste (England and Wales) (Amended) Regulations 2016.

Defra's ***Strategy for Hazardous Waste Management in England (2010)*** sets out the following principles for hazardous waste management:

- waste hierarchy;
- infrastructure provision;
- reduce our reliance on landfill;
- no mixing or dilution;
- treatment of hazardous organic wastes; and
- end reliance on the use of Landfill Directive waste acceptance criteria derogations.

The ***National Policy Statement for Hazardous Waste (Defra, 2013)*** provides the framework for decisions on proposals for new nationally significant hazardous waste infrastructure. This is separate and distinct from the National Policy Statement for Radioactive Waste Geological Disposal Facilities (hazardous waste facilities being distinct from the facilities for the geological disposal of higher activity radioactive waste).

The ***Resource Security Action Plan (Defra, 2012)*** provides a framework for business action to address risks about the availability of some non-renewable raw materials (including minerals), and sets out high level actions to build on the developing partnership between Government and businesses to address resource concerns. This Action Plan emphasises the need to make best use of resources currently in use, reducing as far as practicable the quantity of material used and waste generated, and using as much recycled and secondary material as possible, before securing the remainder of material needed through new primary extraction.

The 2014 White Paper ***Implementing Geological Disposal*** sets out the UK Government's policy framework for managing higher activity radioactive waste in the long term through geological disposal. It also sets out a number of key principles and commitments that will shape the subsequent process of working with communities to identify and assess potential sites that affects England. In this context, the White Paper details the Government's intention to amend the ***Planning Act 2008*** to bring Geological Disposal Facilities (GDFs) and investigative deep boreholes in England within the definition of Nationally Significant Infrastructure Projects (NSIPs), and to designate a NPS in support of this approach. In consequence, the ***Infrastructure Planning (Radioactive Waste Geological Disposal Facilities) Order 2015,*** which came into force on the 27th March 2015, amended the Planning Act 2008 to extend the categories of NSIPs to include development relating to a GDF.

Scotland

The ***revised Waste Framework Directive*** has been transposed into law in Scotland through the following legislation, as amended:

- The National Waste Management Plan for Scotland Regulations 2007 (SSI 2007/251);
- The Waste Management Licensing (Scotland) Regulations 2011 (SSI 2011/228);
- The Waste (Scotland) Regulations 2011 (SSI 2011/226) and The Waste (Scotland) Regulations 2012 (SSI 2012/148); and
- Consequential amendments to existing pollution prevention/control and landfill regulations.

Choosing our Future: Scotland's Sustainable Development Strategy 2005 reflects the five principles found within the UK Sustainable Development Strategy and includes objectives on protecting Scotland's natural heritage and resources. ***Scotland's Government Economic Strategy*** (2015) reaffirms the Scottish Government's commitment to delivering increased sustainable economic growth.

Safeguarding Scotland's Resources – Blueprint for a More Resource Efficient and Circular Economy (2013) is a programme committed to making an immediate impact in Scotland's resource consumption, encouraging a reduction in raw material use to benefit the environment and economy. ***Making things Last: Consultation on creating a more circular economy in Scotland (2015)*** explores the priorities for building a more circular economy – where products and materials are kept in high value use for as long as possible.

Scotland's ***Zero Waste Plan (2010)*** sets out the Scottish Government's vision for a zero waste society. To achieve this vision, the Plan sets out new measures including:

- development of a Waste Prevention Programme for all wastes, ensuring the prevention and reuse of waste is central to all actions and policies;
- landfill bans for specific waste types therefore reducing greenhouse gas emissions and capturing the value from these resources;
- separate collections of specific waste types, including food, to avoid contaminating other materials, increasing reuse and recycling opportunities and contributing to renewable energy targets;
- two new targets that will apply to all waste: 70% target recycled, and maximum 5% sent to landfill, both by 2025;

- restrictions on the input to all energy from waste facilities;
- encouraging local authorities and the resource management sector to establish good practice commitments and to work together to create consistent waste management services, benefitting businesses and the public;
- improved information on different waste sources, types and management highlighting further economic and environmental opportunities; and
- measuring the carbon impacts of waste to prioritise the recycling of resources which offer the greatest environmental and climate change outcomes.

Scotland's ***National Planning Framework 3 (2014)*** sets out the spatial strategy for Scotland over the next 20 to 30 years. It is a spatial expression of the Government Economic Strategy and of its plans for development and investment in infrastructure. This strategy is underpinned by the following aims:

- to create high quality, diverse and sustainable places that promote well-being and attract investment;
- to achieve at least an 80% reduction in greenhouse gas emissions by 2050;
- to respect, enhance and make responsible use of its natural and cultural assets;
- to maintain and develop good internal and global connections.

Water management and flooding is highlighted as a key issue that is thought to become increasingly important, as are changing water supplies and water quality issues as some of a number of issues that should be factored into planning decisions over the longer term. Moreover, Scotland's abundant water resources are valued for their contribution to quality of life; specifically through the food and drink sector.

Demand for minerals is sought to support the construction and energy sectors and the Government's ambition for diversifying the energy mix. However, the need to actively address the past impacts of mineral extraction, through restoration and enhancement is highlighted.

The framework sets out 30 Actions to ensure that the delivery of priorities is co-ordinated with other strategies and targets for the Scottish Government and its agencies. As part of aspirations to deliver a 'low carbon place', the framework requires the Highland Council, and Dumfries and Galloway Council to continue to work with partners and communities to develop planning frameworks associated with the decommissioning of nuclear power stations at Dounreay and Chapelcross.

The framework recognises that some of Scotland's coal and nuclear power stations are nearing the end of their current life. Moreover, there will be no nuclear new build in Scotland, but the possibility of extending the operating life of Scotland's existing nuclear power stations at Hunterston B and Torness, is not ruled out.

Site decommissioning is progressing at former nuclear generation sites at Dounreay in Caithness, Hunterston A in Ayrshire and Chapelcross in Dumfries and Galloway, as are plans for an economically sustainable future for those sites and their wider areas. Similar challenges are considered to arise for areas around Hunterston B and Torness, following future decommissioning.

The ***Scottish Planning Policy (2014)*** sets out policies for (inter alia) the extraction of resources. It stipulates that the planning system should:

- safeguard workable resources and ensure that an adequate and steady supply is available to meet the needs of the construction, energy and other sectors;
- minimise the impacts of extraction on local communities, the environment and the built and natural heritage; and
- secure the sustainable restoration of sites to beneficial afteruse after working has ceased.

In recognition of Scotland's Zero Waste Plan (2010), the SPP (2014) states that the planning system should help deliver infrastructure at appropriate locations, prioritising development in line with the waste hierarchy.

Planning Advice Note: PAN 50 controlling the environmental effects of surface mineral workings (October 1996) provides advice on the more significant environmental effects arising from mineral working operations.

The Scottish Government's ***Online Planning and Waste Management Advice (July 2015)*** complements the National Planning Framework 3 (2014), SPP (2014) and Scotland's Zero Waste Plan (2010). It reiterates Scottish Government Policy published in January 2011 that the long-term management of higher activity radioactive waste should be in near-surface facilities. It replaces PAN 63 under Part 2 of the National Waste Management Plan for Scotland Regulations 2007.

Scotland's ***Higher Activity Radioactive Waste Policy (2011)*** provides the framework for the long-term management of higher activity radioactive waste arising Scotland. The Scottish Government's policy for higher activity radioactive waste is to support long-term near surface, near site storage and disposal facilities so that the waste can be monitored and is retrievable and the need for transporting it over long distances is minimised. The aim of the Policy is to ensure that all activities for the long-term management of the waste are made in a way that protects the health and interests of people and the integrity of the environment now and in the future. The Strategy does not address site-specific issues nor is it prescriptive about which management solutions should be used in specific circumstances. The Strategy instead sets out the key stages for the effective implementation of the 2011 Policy and outlines key actions that are required from the NDA and the Scottish Government during those phases.

In relation to the management of radioactive materials, the Radioactive Substances Act 1993 Amendment (Scotland) Regulations 2011 (SSI 2011/207) amend the Radioactive Substances Act 1993 to align it more closely with the structure and terminology used in the ***Council Directive 96/29/Euratom***. The ***Radioactive Substances Act 1993: The Hass (Scotland) Directions 2005*** are made by the Scottish Ministers to SEPA, requiring compliance with the provisions of Council Directive 2003/122/Euratom ("the HASS Directive") on the control of high-activity sealed radioactive sources and orphan sources in the exercise of existing regulatory powers. These Directions supplement the ***High-activity Sealed Radioactive Sources and Orphan Sources Regulations 2005*** (SI 2005/2686).

Wales

Part 1 of the ***Environment (Wales) Act 2016*** is concerned with the sustainable management of natural resources. It makes provisions for a new iterative process for the Welsh Ministers, Natural Resources Wales and other public bodies to contribute to achieving the sustainable management of natural resources. Part 1 of the Act also defines natural resources, sustainable management of natural resources and the principles of sustainable management of natural resources, and it confers functions on the Welsh Ministers and others to assist in the delivery of sustainable management of natural resources. Part 4 of the Act, meanwhile, is concerned

with the collection and disposal of waste, and makes provision for requiring source segregation and separate collection of waste, banning the incineration of waste and banning the disposal of food waste to sewer from non-domestic premises. The purpose of the provisions is to promote increased separation of different types of waste, and prohibit certain forms of disposal of recoverable types of waste.

Planning Policy Wales (Edition 9): Chapter 12 Infrastructure and Services (2016) deals with infrastructure and services; specifically issues of water supply and waste water management, waste management, energy supply from renewable and low carbon sources, and telecommunications. The overriding objective is for local planning authorities to "*maximise the use of existing infrastructure and should consider how the provision of different types of infrastructure can be co-ordinated*".

Towards Zero Waste (2010) is the overarching waste strategy document for Wales. It was published in 2010. The document sets out at a high-level strategy for the management of waste in Wales to produce benefits not only for the environment, but also for the economy and social wellbeing. Delivery actions have been developed in a series of sector plans, a ***Waste Prevention Programme (2013)*** and ***Technical Advice Note (TAN) 21: Waste (2014)***, which provide advice on the role of land use planning in the management and control of waste. The Welsh Government has also created the ***Natural Resource Management Programme*** to take forward the policy commitments proposed in the ***Sustaining a Living Wales Green Paper on a New Approach to Natural Resource Management in Wales (2012).*** This Programme includes:

- natural resource management policy, including the setting of national priorities;
- the Environment Bill;
- embedding the ecosystem approach, including associated demonstration projects which will showcase the benefits this approach can bring, and from which we can learn about how and when the approach can be used;
- working with Natural Resources Wales and coordinating performance management arrangements; and
- communications, engagement and knowledge sharing.

Those waste regulation that apply to England as identified above also apply to Wales, namely the Waste (England and Wales) Regulations 2011 as amended by the Waste (England and Wales) (Amendment) Regulations 2012 and the Waste (England and Wales) (Amendment) Regulations 2014.

The **Hazardous Waste (Wales) Regulations 2005** set out the regime in Wales for the control and tracking of the movement of hazardous waste, as amended by The Hazardous Waste (Wales) (Amendment) Regulations 2009 and The Hazardous Waste (Miscellaneous Amendments) (Wales) Regulations 2015.

Technical Advice Note (TAN) 12: ***Design (2014)*** sets out the Welsh Government's land use planning policy in respect of promoting sustainability through good design. Achieving the efficient use and protection of natural resources is identified as an objective for good design. ***Minerals Technical Advice Note (MTAN) Wales 1: Aggregates (March 2004)*** sets out planning policy guidance in relation to aggregates extraction and related development in Wales is to provide aggregate resources in a sustainable way to meet society's needs in respect of aggregates related development.

The ***Welsh Government Policy on the Management and Disposal of Higher Activity Radioactive Waste (2015)*** sets out that the Welsh Government has adopted a policy of geological disposal for the long-term, safe and secure management of higher activity radioactive waste. It states that a GDF will only be deliverable in Wales on the basis of a voluntary partnership with interested local communities willing to enter into discussions about potentially hosting a GDF and the successful conclusion of those discussions.

Overview of the Baseline

UK

The UK Statistics on waste for December 2016[309] includes the following key points:

- The UK recycling rate for 'waste from households' was 44.3 per cent in 2015, falling from 44.9 per cent in 2014. This is the first time the rate has fallen since it began in 2010, though the 2015 figure still represents the second highest annual value on record. There is an EU target for the UK to recycle at least 50 per cent of household waste by 2020.
- UK Biodegradable Municipal Waste (BMW) sent to landfill has continued to reduce and in 2015 was 7.7 million tonnes. This represents 22 per cent of the 1995 baseline value. There is an EU target to restrict BMW landfilled to 35 per cent of the 1995 baseline by 2020. The UK comfortably met interim targets for 2010 and 2013.
- The recovery rate from non-hazardous construction and demolition waste in the UK in 2014 was 89.9 per cent. There is an EU target for the UK to recover at least 70 per cent of this type of waste by 2020.
- UK generation of commercial and industrial (C&I) waste was 27.7 million tonnes. This has fallen from 32.8 million tonnes in 2012.
- The UK generated 202.8 million tonnes of total waste in 2014. Over half of this (59.4 per cent) was generated by construction, demolition and excavation, with households responsible for a further 13.7 per cent.
- Of the 209.0 million tonnes of all waste that entered final treatment in the UK in 2014, 44.5% was recovered (including recycling and energy recovery). The proportion that went to landfill was 23.1 per cent.
- In 2014, 64.1 per cent of UK packaging waste was either recycled or recovered compared to 72.7 per cent in 2013. The 2014 EU target was for the UK to recycle or recover at least 60 per cent of packaging waste.

Radioactive Waste

Higher activity radioactive waste comprises a number of categories of radioactive waste – high level waste (HLW), intermediate level waste (ILW), and low level waste (LLW) – that is not suitable for near-surface disposal in current facilities. Higher activity radioactive wastes are produced as a result of the generation of electricity in nuclear power stations, from the

[309] Defra (2016) *UK Statistics on Waste*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/593040/UK_statsonwaste_statsnotice_Dec2016_FINALv2_2.pdf

associated production and reprocessing of the nuclear fuel, from the use of radioactive materials in industry, medicine and research, and from defence-related nuclear programmes.

HLW is defined as waste in which the temperature may rise significantly as a result of its radioactivity, such that this factor has to be taken into account in designing storage or disposal facilities. HLW arises in the UK initially as a liquid that is a by-product from the reprocessing of spent nuclear fuel. HLW is being converted into solid glass form using a treatment process called 'vitrification'. Current plans are that this solid glass waste will be stored for a number of decades, to allow a significant proportion of the radioactivity to reduce through a natural decay process, and for the waste to become cooler, so as to make it easier to transport and dispose of.

ILW is defined as waste with radioactivity levels exceeding the upper boundaries for low-level wastes, but which does not require heat to be taken into account in the design of storage or disposal facilities. ILW arises mainly from the reprocessing of spent fuel and from general operations and maintenance at nuclear sites, and can include solid metal items such as fuel cladding and reactor components, and sludges from the treatment of radioactive liquid effluents. As decommissioning and clean-up of nuclear sites proceeds, more ILW will arise. Typically, ILW is treated in solid form and packaged in purpose-designed containers, manufactured from stainless steel, iron or concrete.

LLW is the lowest activity category of radioactive waste. LLW currently being generated in the UK consists largely of paper, plastics and scrap metal items that have been used in hospitals, research establishments and the nuclear industry. Although LLW makes up more than 90% of the UK's radioactive waste legacy by volume, it contains less than one-tenth of 1% of the total radioactivity. Most operational low level waste in the UK is sent to the national LLW repository near the village of Drigg in west Cumbria, where it is encapsulated in cement and packaged in large steel containers, which are then placed in an engineered vault a few metres below the surface. A small fraction of the total volume of LLW cannot be disposed of in this way, due principally to the concentration of specific radionuclides and so will need to be disposed of in a GDF. A sub-category of LLW is Very Low Level Waste (VLLW). This comprises small volumes principally from hospitals and universities that can be safely disposed of with municipal, commercial or industrial waste (either directly or after incineration), and larger volumes from nuclear sites that can be disposed of too appropriately permitted landfill facilities.

As a pioneer of nuclear technology, the UK has accumulated a legacy of higher activity radioactive waste and material. Some of this is being stored on an interim basis at nuclear sites across the UK. More waste will arise as existing facilities reach the end of their lifetime and are decommissioned and cleaned up, and through the operation and decommissioning of any new nuclear power stations.

The NDA 2016 UK Radioactive Waste & Materials Inventory provides comprehensive and up-to-date information on radioactive waste and materials in stock and estimated to arise in future. **Table 10.1** shows the total volume of radioactive waste by type.

Table 10.1 Volume of Radioactive Waste by Type in the UK

Waste category	Reported 1st April 2016	Estimated future arisings	Lifetime total
HLW	1,960	-820	1,150
ILW	99,000	191,000	290,000
LLW	30,100	1,320,000	1,350,000
VLLW	935	2,860,000	2,860,000
Total	**132,000**	**4,360,000**	**4,490,000**

Source: NDA UK Radioactive Waste & Materials Inventory 2016[310]

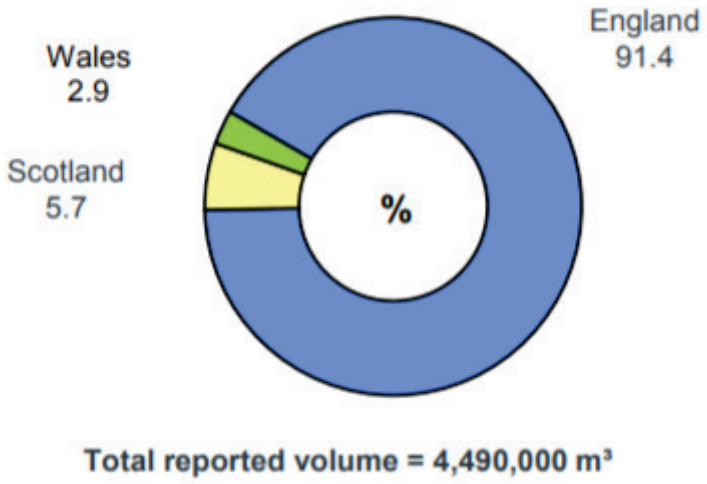
Waste at 1 April 2016 includes all radioactive materials that had been declared as waste and were being held at this date. The volumes reported are those that the wastes occupied in tanks, vaults, silos, drums and other vessels in which they were contained. Many of these wastes existed in either an untreated or partly treated state. Others had already been conditioned for long-term management.

At 1 April 2016 the reported volume of radioactive waste in stock in the UK was about 132,000m^3 (about 165,000 tonnes).

The Inventory highlights that although the volume of HLW is relatively small, it contains around 95% of all radioactivity in radioactive wastes (LLW contains less than 0.01% of the total radioactivity) and that these percentage values will change gradually over future time as radioactivity decays.

Figure 10.1 highlights the relevant contribution of radioactive waste arising from the countries within the UK.

Figure 10.1 Total waste reported by country

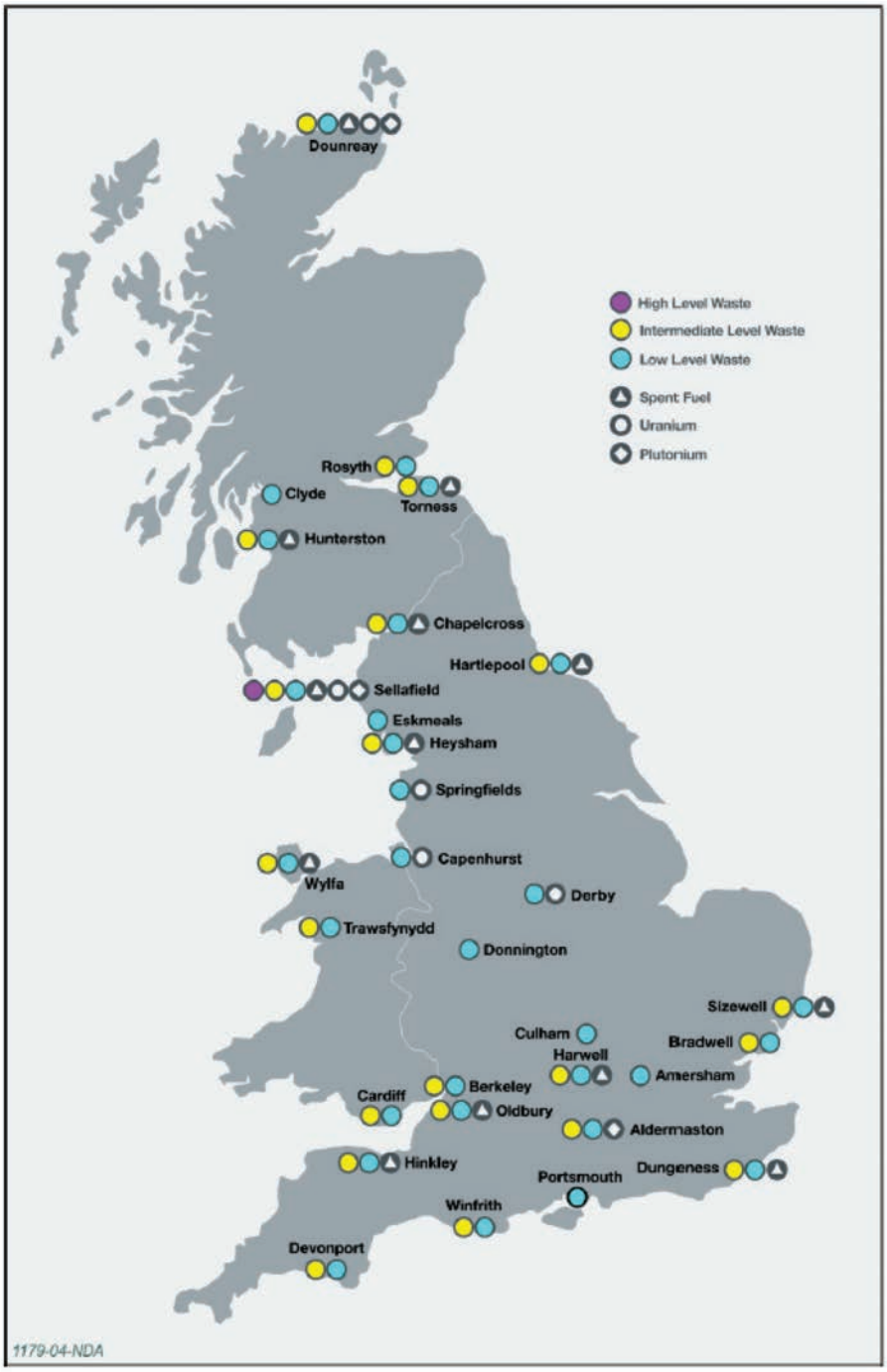


[310] Nuclear Decommissioning Authority (2016) *UK Radioactive Waste & Materials Inventory 2016*. Available online at: https://ukinventory.nda.gov.uk/the-2016-inventory/2016-uk-data/

Source: UK Radioactive Waste & Materials Inventory 2016

Figure 10.2 shows sites where radioactive waste and materials are currently stored in the UK. There are three LLW disposal sites within Great Britain; the main national repository is the LLW Depository near Drigg, in England. Further LLW disposal sites are at Dounreay and Clifton Marsh. At present there are no facilities in the UK for disposing of LLW not suitable for near-surface disposal, ILW and HLW – and these wastes are currently stored.

Figure 10.2 Sites Where Radioactive Waste and Materials are Currently Stored



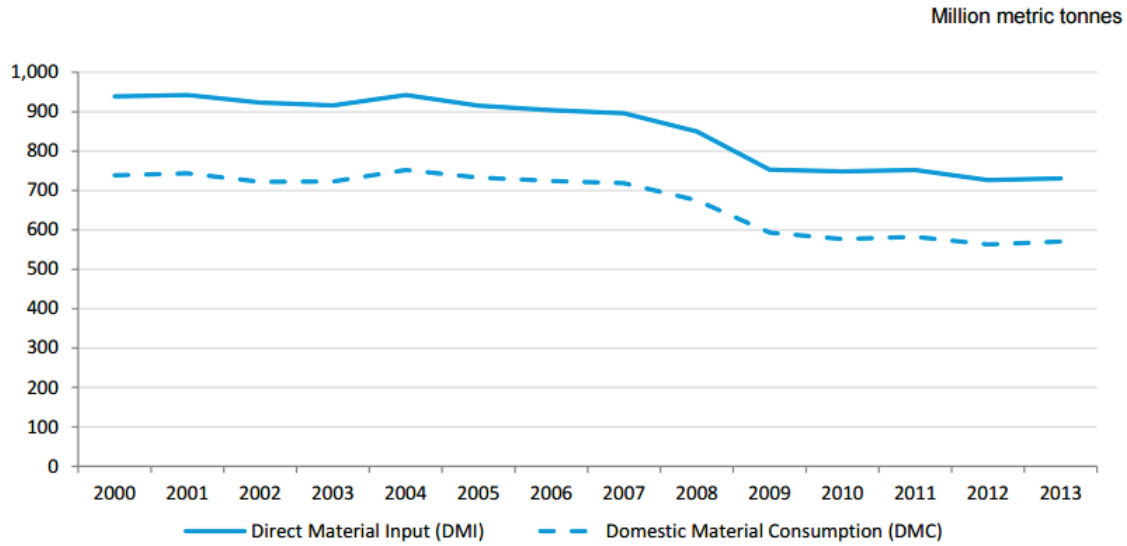
Source: DECC (2014) *Implementing Geological Disposal: A framework for the long-term management of higher activity radioactive waste*.[311]

[311] DECC (2014) *Implementing Geological Disposal: A framework for the long-term management of higher activity radioactive waste.* Available online at:
https://www.gov.uk/government/publications/implementing-geological-disposal

Resource Use and Minerals

According to Defra Resource Statistics (2015)[312], in 2013, the Domestic Material Consumption (DMC) was 570 million tonnes, and Direct Material Input (DMI) was 731 million tonnes – the lowest levels recorded on its records (See **Figure 10.3**)

Figure 10.3 UK Direct Material Input and Domestic Material Consumption, 2000 – 2012



Notes: Direct Material Input (DMI) (Domestic extraction + Imports) measures the total amount of materials available for use in the economy, Domestic Material Consumption (DMC) (Domestic extraction + Imports – Exports) measures the amount of materials used in the economy, and is calculated by subtracting exports from DMI.

Source: DEFRA: Digest of Waste and Resources Statistics – 2016 Edition.

Table 10.2 summarises totals for extractors' sales of material for agricultural and industrial uses for 2013 for different mineral types[313].

Table 10.2 Summary of totals for extractors' sales of material for agricultural, industrial and construction uses for 2013 for different mineral types

Mineral Type	UK Total Extractors' sales of material for agricultural and industrial uses for 2013 (Thousand tonnes)
Limestone, Dolomite and Chalk	69,640
Industrial Sand	3,948
Sand and Gravel	56,129
Sandstone	9,737
Igneous Rock	338,283

[312] Defra (2016) *Digest of Waste and Resource Statistics – 2016 Edition (revised)*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/567502/Digest_waste_resource_2016_rev4.pdf
[313] DCLG (2014) *Mineral Extraction in Great Britain 2014*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505631/Mineral_Extraction_in_Great_Britain_2014_final.pdf

Mineral Type	UK Total Extractors' sales of material for agricultural and industrial uses for 2013 (Thousand tonnes)
Peat	795
Crushed Rock	98,423
Clay & Shale	6,806
Chalk*	3,312
Fireclay	129

*NB only those parts of GB producing chalk are identified.

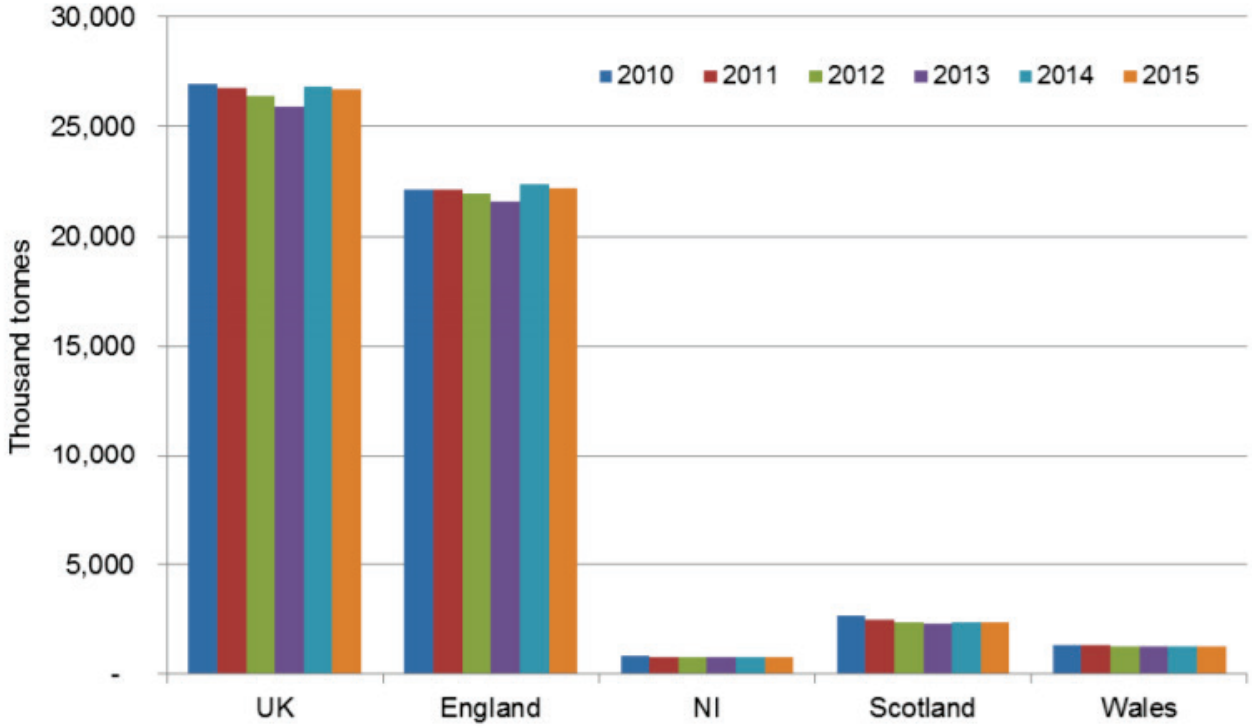
Source: DCLG: Mineral Extraction in Great Britain 2014, Business Monitor PA1007 (March 2016).

England

Waste

As can be seen in **Figure 10.4**, England is responsible for the majority of waste to landfill generated in the UK, with levels remaining relatively stable from 2010 – 2015.

Figure 10.4 Quantity of waste from households 2010-2015



Source: Defra

Commercial and industrial waste arising for the UK and England are show in **Table 10.3**. The term 'commercial and industrial' spans a range of economic activities (based on the European NACE statistical classification of economic activities in the European Community) including manufacturing, industrial processes and service based enterprises. The UK Commercial and

Industrial sectors generated 27.7 million tonnes of waste in 2014, of which 19.8 million tonnes was in England.

Table 10.3 Total waste generation from the commercial and industrial sectors 2010-2014

million tonnes

	UK			England		
	Commercial	Industrial	Total C&I	Commercial	Industrial	Total C&I
2010	20.0	13.9	33.9	13.1	9.5	22.6
2011	UK 2011 Estimates not available			England 2011 Estimates not available		
2012	16.9	15.9	32.8	12.9	11.3	24.2
2013	UK 2013 Estimates not available			11.6	10.4	21.9
2014	15.1	12.6	27.7	11.1	8.7	19.8

Source: Defra statistics

The household recycling rate in England in 2015 was 43.9%, an increase of 2.7% since 2010 but below the UK rate of 44.3%[314].

Radioactive Waste

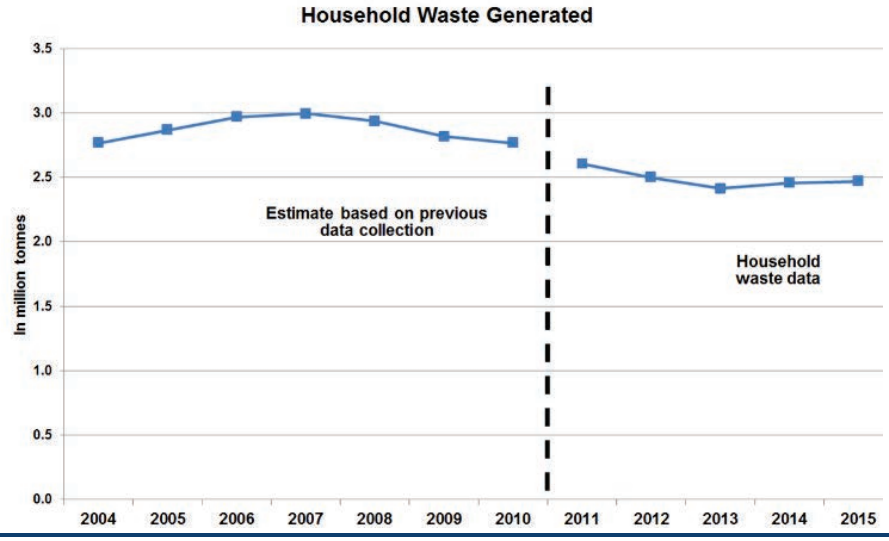
According to the 2016 UK Radioactive Waste and Materials Inventory, approximately 91% by volume of all radioactive wastes in the UK are produced in England with the most waste produced at Sellafield and the nuclear power stations. The main national repository is the LLW Repository near Drigg, in England.

Scotland

Waste

As shown in **Figure 10.5**, between 2004 and 2007 the amount of household waste generated in Scotland increased from 2.77 million tonnes to 3.00 million tonnes, before falling back to 2.77 million tonnes in 2010. Between 2011 and 2015, the total amount of household waste generated fell by 5.3% (0.14 million tonnes)[315].

Figure 10.5 Household Waste Generation in Scotland (2004-2015)



[314] Defra (2016) *UK Statistics on Waste*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/593040/UK_statsonwaste_statsnotice_Dec2016_FINALv2_2.pdf
[315] Scottish Government (2016) *Household Waste Generated - High Level Summary of Statistics Trend*. Available online at: http://www.gov.scot/Topics/Statistics/Browse/Environment/TrendHouseholdWaste

Source: Scottish Government (2016). Household Waste Generated - High Level Summary of Statistics Trend.

Between 2005 and 2014, the amount of Scottish waste sent to landfill decreased by 42%. Over the same period, the amount of biodegradable municipal waste landfilled in Scotland decreased by 51%. The household waste recycling rate in 2015 was 44.2%, increasing from 42.8% in 2014. There has also been a decline in households throwing food out with general waste, from 73% in 2012 to 55% in 2015. The proportion of households reporting that they recycled a range of other waste items increased each year between 2003 and 2011, however between 2011 and 2015 there was little change in the percentage of households recycling each item, except for plastic bottles which increased by 7 percentage points to 82%[316].

Radioactive Waste

According to the 2016 UK Radioactive Waste & Materials Inventory, approximately 6% by volume of radioactive wastes in the UK are produced in Scotland with the most waste produced at Dounreay and the nuclear power stations. Radioactive waste is managed at 7 sites and a new LLW disposal facility opened at Dounreay in 2015 which is intended to support the decommissioning of redundant facilities at the site.

Wales

Waste

In 2015-16 total municipal waste produced in Wales amounted to approximately 1.59 million tonnes, of which approximately 289,000 tonnes of waste were sent to landfill. The percentage of waste which was reused, recycled or composted stood at 60.2%, up from 56.2% in 2014-15[317].

The most recent figures for Industrial and Commercial Waste in Wales date back to 2007. Key results from this survey include:

- Welsh industrial and commercial sectors generated an estimated 3.6 million tonnes of waste, with 53% from industrial companies and 47% from commercial companies; and
- in addition, 1.8 million tonnes of 'non-wastes' were produced, specifically blast furnace slag and virgin timber[318].

Radioactive Waste

According to the 2016 UK Radioactive Waste and Materials Inventory, approximately 3% by volume of radioactive wastes in the UK are produced in Wales with the most waste produced at the nuclear power stations. Radioactive waste is managed at 3 sites in Wales, the NDA Magnox reactor station sites at Trawsfynydd and Wylfa – the former is shut down and being decommissioned, the latter is operational (though due to be decommissioned shortly) and a new power station is proposed; and GE Healthcare's Maynard Centre at Cardiff.

At present there are no facilities in Wales for disposing of LLW and ILW – these wastes are currently stored and transported to the repository in Drigg, England.

[316] Scottish Government (2016) *Key Scottish Environment Statistics 2016*. Available online at: http://www.gov.scot/Resource/0050/00508344.pdf
[317] Welsh Government (2016) *Waste managed (tonnes) by management method and year*. Available online at: https://statswales.wales.gov.uk/Catalogue/Environment-and-Countryside/Waste-Management/Local-Authority-Municipal-Waste/Annual/wastemanaged-by-management-year
[318] Environment Agency (2007) *Survey of Industrial and Commercial Waste Arisings in Wales*. Available online at: http://gov.wales/statistics-and-research/industrial-commercial-waste-survey/?lang=en

Summary of Existing Problems Relevant to the Geological Disposal NPS

The following existing problems for waste and resource use have been identified:

- The total amount of municipal and commercial and industrial waste produced each year is likely to decrease in coming years.
- The consumption of non-renewable sources will deplete overall stocks and result in a scarcity of resources for future generations.
- Facilities for disposing of higher activity wastes, which include LLW not suitable for near-surface disposal, ILW and HLW, have yet to be developed in the UK.

Likely Evolution of the Baseline

UK

Reported volumes for all waste types are similar to those in the NDA 2013 Inventory. The numbers of HLW and ILW packages has increased as progress continues in conditioning these wastes for long-term management. A number of waste streams show changes in volume and radioactivity as inventories have been updated. The number of waste packages has increased from 23,958 in 2001 to 66,836 in 2016 and would be expected to continue to increase.

HLW is generated from reprocessing spent nuclear fuel at Sellafield. Future arisings are forecast from continuing Magnox and oxide fuel reprocessing. In the 2016 Inventory, Magnox reprocessing is scheduled to end in 2020 and oxide reprocessing around 2018.

Reported volumes of HLW will actually fall in the future. There are two reasons for this. The first and most significant reason is that HLW is initially stored as a liquid (HAL), which will later undergo an evaporation process before vitrification into glass blocks. The vitrified glass blocks produced are roughly one-third of the volume of the original HAL. The second reason is that future arisings of HLW are net of exports to overseas reprocessing customers.

Sellafield currently forecasts that operations to produce vitrified HLW will end in around 2021; although further vitrified wastes will arise during the subsequent Post Operational Clean Out (POCO) phase, which is expected to continue until 2029. Total future arisings amount to 1,870 waste packages (366 m3 packaged volume).

The reported volume for forecast future arisings of ILW is about 191,000 m3. About 60% (115,000 m3) is from Sellafield. Most of the other ILW is from Magnox power station sites (42,900 m3) and AGR power station sites (21,200 m3). About 62% (119,000 m3) of all forecast future arisings are from decommissioning of existing reactors and other facilities. The remainder are from ongoing plant operations.

The forecast future arisings of LLW are about 1,320,000 m3. This includes about 213,000 m3 of mixed LLW/VLLW from Springfields. About 35% (465,000 m3) of all forecast future LLW arisings are from Magnox power station sites (excluding Calder Hall). Much of the other LLW is from Sellafield (330,000 m3 - including 40,400 m3 from Calder Hall), Springfields (214,000 m3), AGR power stations (110,000 m3), and Dounreay (82,100 m3).

The forecast future arisings of VLLW are about 2,860,000 m3. About 95% (2,700,000 m3) of this volume is attributable to waste from the decommissioning of reprocessing and associated plants, waste storage and treatment plants, and site service facilities at Sellafield. However, there is a large uncertainty about how much of this will be managed as radioactive waste;

current expectations are that about 70% of this material, which comprises concrete, brick and metal from building structures, may be out of scope of regulatory control. As decommissioning projects at the site are progressed and opportunities for further characterisation arise the projected amounts of radioactive waste will continue to be refined.

Figure 10.6 illustrates how the total radioactivities of HLW, ILW, LLW and VLLW change with time after 1 April 2016.

Figure 10.6 Total radioactivity of wastes as a function of time post 1 April 2016

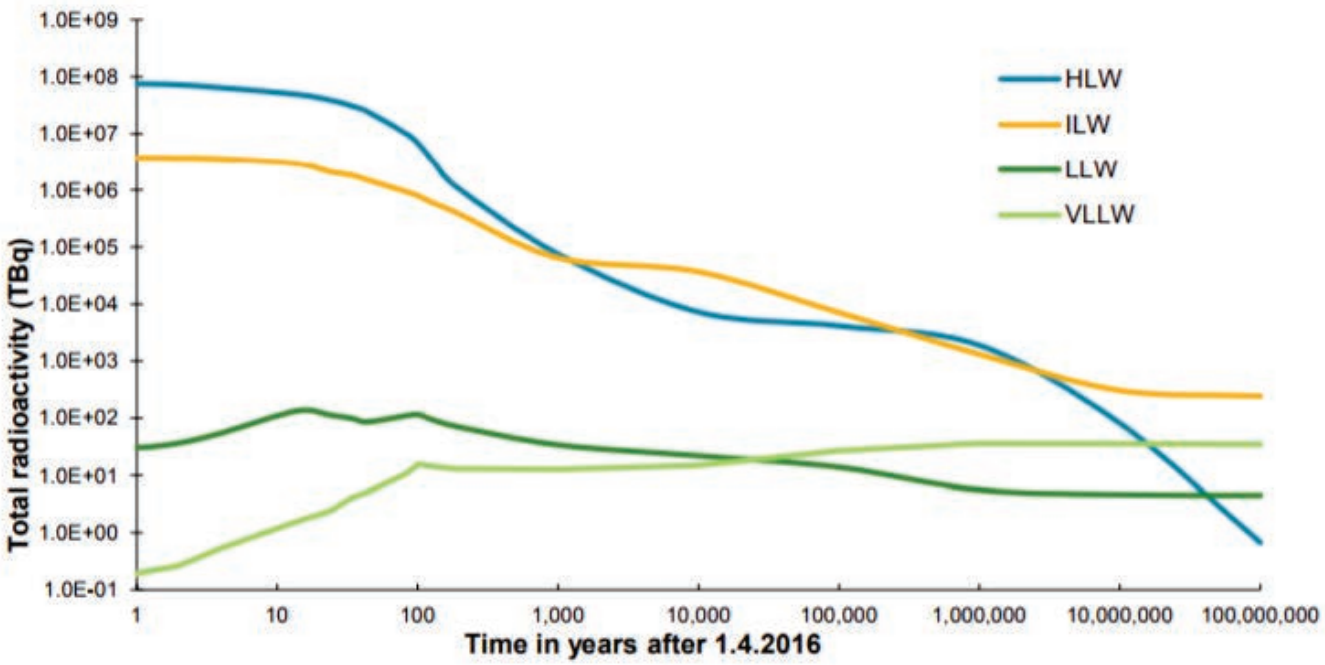


Figure 10.7 provides a breakdown of the current and future waste volumes and package numbers for HLW, ILW and LLW for each waste producing organisation.

Figure 10.7 Reported volume at 1 April 2016 and estimated for future arisings (m^3)

Site owner		HLW	ILW	LLW	VLLW	Total
NDA	**Total**	**1,150**	**252,000**	**1,130,000**	**2,830,000**	**4,210,000**
	1.4.2016	1,960	90,600	25,500	909	**119,000**
	Future arisings	See Note 2	161,000	1,100,000	2,830,000	**4,090,000**
Ministry of Defence	**Total**	**0**	**9,120**	**44,200**	**8,100**	**61,500**
	1.4.2016	0	4,480	2,150	26.0	**6,650**
	Future arisings	0	4,640	42,100	8,080	**54,800**
EDF Energy	**Total**	**0**	**29,200**	**139,000**	**0**	**168,000**
	1.4.2016	0	3,520	624	0	**4,140**
	Future arisings	0	25,600	138,000	0	**164,000**
United Kingdom Atomic Energy Authority	**Total**	**0**	**193**	**4,810**	**0**	**5,000**
	1.4.2016	0	34.1	86.0	0	**120**
	Future arisings	0	159	4,720	0	**4,880**
GE Healthcare	**Total**	**0**	**454**	**4,610**	**0**	**5,070**
	1.4.2016	0	399	513	0	**911**
	Future arisings	0	55.2	4,100	0	**4,160**
Urenco	**Total**	**0**	**2.5**	**13,100**	**21,000**	**34,100**
	1.4.2016	0	0.7	632	0	**633**
	Future arisings	0	1.8	12,400	21,000	**33,400**
Minor waste producers	**Total**	**0**	**11.5**	**12,200**	**0**	**12,200**
	1.4.2016	0	5.3	648	0	**653**
	Future arisings	0	6.2	11,600	0	**11,600**
Total	**Total**	**1,150**	**290,000**	**1,350,000**	**2,860,000**	**4,490,000**
	1.4.2016	**1,960**	**99,000**	**30,100**	**935**	**132,000**
	Future arisings	**See Note 2**	**191,000**	**1,320,000**	**2,860,000**	**4,360,000**

Source: NDA 2016

England

Defra has established targets for England which includes a greater focus on waste prevention, seeking to achieve a fall of 50% per person in household waste arising. Recycling and composting of household waste targets have been established - at least 50% by 2020; and recovery of municipal waste - 75% by 2020.

On the basis of an evaluation of the development of waste streams in the future set out in the Waste Management Plan for England[319], commercial and industrial waste arisings are predicted to fall to 43.9 million tonnes by 2020.

Scotland

Under the 'Zero Waste Plan', the Scottish Government has set a long-term target of 70% recycling/ composting and preparing for reuse of all waste arising in Scotland by 2025,

[319] Defra (2013) *Waste Management Plan for England.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265810/pb14100-waste-management-plan-20131213.pdf

regardless of its source. The Scottish Government has also set a target of no more than 5% of all waste produced to go to landfill by 2025[320].

The Scottish Government is not a sponsor of the programme for implementing geological disposal, but does remain committed to dealing responsibly with radioactive waste arising in Scotland and in January 2011, the Scottish Government published ***Scotland's Higher Activity Waste Policy 2011***. Scottish Government policy is that the long-term management of higher activity radioactive waste should be in near-surface facilities. Facilities should be located as near to the sites where the waste is produced as possible. While the Scottish Government does not support deep geological disposal, it continues, along with the UK Government and other devolved administrations, to support a robust programme of interim storage and an ongoing programme of research and development.

Wales

With regard to commercial wastes, Towards Zero Waste – One Wales: One Planet[321] seeks to increase recycling from 57% in the period 2015/16 and to 70% in 2024/25. For industrial wastes, recycling is targeted to increase from 63% in the period 2015/16 to 70% in 2024/25.

The Welsh Government has participated in the Managing Radioactive Waste Safely (MRWS) programme since its inception in 2001. The Welsh Government is committed to securing the long-term safety of radioactive wastes and to the implementation of a disposal framework appropriate to the needs of Wales and will continue to play an active part in the MRWS programme to promote the interests of the people of Wales.

As highlighted in **Section 10.2**, the Welsh Government has adopted a policy of geological disposal for the long-term, safe and secure management of higher activity radioactive waste. It states that a GDF will only be deliverable in Wales on the basis of a voluntary partnership with interested local communities willing to enter into discussions about potentially hosting a GDF and the successful conclusion of those discussions.

Assessing Significance

The objectives and guide questions related to waste and resource use which have been identified for use in the appraisal of the effects of Geological Disposal Infrastructure NPS proposals are set out in **Table 10.4**, together with reasons for their selection.

[320] Scottish Environment Protection Agency (2010) *Scotland's Zero Waste Plan Data.* Available online at: https://www.sepa.org.uk/environment/waste/waste-data/
[321] Welsh Assembly Government (2010) *Towards Zero Waste - One Wales: One Planet*. Available online at: http://gov.wales/docs/desh/publications/100621wastetowardszeroen.pdf

Table 10.4 Approach to Assessing the Effects of the Geological Disposal infrastructure NPS on Waste and Resource Use

Objective/guide question	Reasoning
To minimise waste arisings, promote reuse, recovery and recycling, minimise the impact of wastes on the environment and communities and contribute to the sustainable use of natural and material assets.	The SEA Directive (2001/42/EC) requires likely significant effects on material assets (including resources) be taken into account in the Environmental Report, which for the purposes of the AoS is incorporated within the AoS Report.
Will the Geological Disposal Infrastructure NPS affect the amount of hazardous and non-hazardous wastes produced?	The Waste Framework Directive (2008/98/EC) promotes a hierarchical approach to waste management with waste prevention at the top of the hierarchy. This is supported through national strategies such as the Waste Management Plan for England. In addition, the Basel Convention promotes minimisation of generation of quantities of hazardous waste in order to prevent against problems and challenges posed by hazardous waste.
Will the Geological Disposal Infrastructure NPS affect the capacity of existing waste management systems, both nationally and locally?	The UK currently has no specific facility or capacity for the disposal of Higher Activity Waste. The 2014 White Paper *Implementing Geological Disposal* sets out the types of radioactive waste to be managed, and a proposed way forward through the creation of a GDF. As such, the proposals will help to create the required capacity to accommodate this particular waste stream.
Will the Geological Disposal Infrastructure NPS maximise re-use and recycling of recovered components and materials?	Recovering and recycling waste will assist in decreasing the amount of waste to landfill. The Landfill Directive (1999/31/EC) aims to reduce amount of biodegradable waste going to landfill to 35% of the 1995 figures by 2020. The Waste Management Plan for England also includes targets for recycling rates.
Will the Geological Disposal Infrastructure NPS help achieve government and national targets for minimising, recovering and recycling waste?	Minimising, recovering and recycling waste will assist in decreasing the amount of waste to landfill. The Landfill Directive (1999/31/EC) aims to reduce amount of biodegradable waste going to landfill to 35% of the 1995 figures by 2020. This is supported through the Waste Management Plan for England.
Will the Geological Disposal Infrastructure NPS increase the burden on limited natural resources?	Conservation of resources and living within environmental limits are underlying objectives of several the international policies such as European Spatial Development Perspective, and national policy, such as Framework for Sustainable Development. The National Planning Policy Framework and Planning Practice Guidance seeks to facilitate the sustainable use of minerals.
Will the Geological Disposal Infrastructure NPS make best use of existing infrastructure and resources?	Use of existing infrastructure and resources will decrease the total resources required and will increase efficiency.

Table 10.5 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the resource use and waste objectives.

Table 10.5 Illustrative Guidance for the Assessment of Significance for Waste and Resource Use

Effect	Description	Illustrative Guidance
++	Significant Positive	• Option would increase the capacity of waste management infrastructure; • Option would create no additional hazardous or non-recyclable waste, whilst maximising the proportion of materials that are re-useable or recyclable; • Option would ensure the safe handling of hazardous wastes; • Option would make best use of existing infrastructure and resources (e.g. buildings and other facilities on sites) and help conserve natural resources.
+	Positive	• Option would not create an increase in the volume of hazardous and non-recyclable wastes that require disposal; • Option would increase the volume of materials reused and recycled; • Option would make best use of existing infrastructure and resources (e.g. buildings and other facilities on sites).
0	Neutral	• Option would not create an increase in the volume of hazardous and non-recyclable wastes that require disposal; • Option would have no effect on the capacity of waste management infrastructure; • Option would not have any impact on existing natural resources.
-	Negative	• Option would increase volumes of hazardous and non-recyclable waste that would require disposal; • Option would have a limited adverse impact on the capacity of existing waste management systems; • Option would require the limited use of natural resources during construction and operational stages.
--	Significant Negative	• Option would generate a high volume of hazardous and non-recyclable waste that would require disposal; • Option would impede the achievement of government and national targets for minimising, recovering and recycling waste; • Option would have a significant adverse impact on the capacity of existing waste management systems (e.g. leading to the permitting of additional landfill capacity to accommodate waste); • Option would increase risks associated with the handling of hazardous wastes; • Option would require a significant volume of natural resources and result in the direct loss of resources.
?	Uncertain	• From the level of information available the effect that the option would have on this objective is uncertain.

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 10.6 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria[322]' and 'No NPS' on the waste and resources objective. The appraisal considers in-turn the three sub-sections used for each topic within Chapter 5 (Impacts) of the draft NPS: Applicant's Assessment; Decision Making; and Mitigation. The performance of the draft NPS and the two reasonable alternatives are scored accordingly, with a commentary provided in the Appraisal column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15 - 20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement. These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-term (less than 20 years); MT – medium-term (between 20 and 170 years); and LT – long-term (more than 170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

[322] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

Table 10.6 Appraisal of the Draft NPS and Reasonable Alternatives: Waste and Resources

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	+	+	+/?	**Draft NPS:** The text in paragraph 5.13.7 of the draft NPS under the heading of 'Applicant's Assessment' states that "*The applicant should set out the arrangements that are proposed for managing any waste produced during the construction, operation and closure of geological disposal infrastructure that cannot be managed at the facility itself. The applicant should prepare a Site Waste Management Plan. The arrangements in the plan should include information on the proposed waste recovery and disposal system for all waste generated by the development and should also include details of the alternatives that have been considered. The applicant must demonstrate that all waste produced by the facility will be managed in accordance with the waste hierarchy…and that, during construction, excavated soil, subsoil and rock will, where possible, be reused. The applicant should seek to minimise the volume of waste produced. The applicant should also seek to minimise the volume of waste sent for disposal unless it can be demonstrated that this is the best overall environmental outcome*." The requirement for applicants to identify the arrangements for the management of waste in accordance with the waste hierarchy, and for the preparation of a site waste management plan (SWMP), will help to ensure that waste arisings associated with the construction, operation and closure of geological disposal infrastructure are minimised and that reuse, recycling and recovery are promoted. It is also noted that reference is made in paragraph 5.13.7 to 'the best overall environmental outcome' which implies a requirement for applicants to consider the wider environmental impacts of waste management. Whilst the reuse of waste including excavated soil, subsoil and rock will help to minimise resource use associated with geological disposal infrastructure, there is currently no specific topic contained in Section 5 of the draft NPS concerning resource use. However, and reflecting that it is a cross cutting theme, a number of other topics in Section 5 and the criteria for 'good design' detailed in Section 4.5 of the draft NPS collectively address this issue. This is considered further below (see 'Other Sections of the draft NPS'). Overall, the draft NPS has been assessed as having a positive effect on waste and resources, although it is noted that as currently drafted, there is no guidance with respect to the assessment of impacts on waste and resources (as part of, for example, any Environmental Statement (ES) (as required) or to siting considerations. *Recommendations for Improvement* It would be useful for the text to make direct reference to National Planning Policy for Waste (2014) and in particular to paragraph 8 which concerns non-waste development. In this context, consideration could be given to the provision of additional guidance requiring that decisions regarding siting and assessments assess: • the likely impact of proposed, non-waste related development on existing waste management facilities (including their capacity to receive and treat/dispose of waste generated by GDF-related development), and on sites and areas allocated for waste management; • the requirement for the provision for waste management facilities and their integration with the rest of the development; and • the handling of waste arising from the construction, operation and closure of GDF-related development to maximise reuse/recovery opportunities, and minimise off-site disposal. Reflecting Planning Practice Guidance on waste (paragraph: 049 Reference ID: 28-049-20141016) and the requirement of

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				the Environmental Impact Assessment (EIA) Directive (as amended) for an ES to include an estimate of quantities and types of waste produced during the construction and operation phases, the guidance could require applicants to prepare waste audits that would cover: • the anticipated type and volumes of waste that the development could generate; • where appropriate, the steps to be taken to ensure the maximum amount of waste arising from development on previously developed land is incorporated within the new development; • the steps to be taken to ensure effective segregation of wastes at source including, as appropriate, the provision of waste sorting, storage, recovery and recycling facilities; and • any other steps to be taken to manage the waste that cannot be incorporated within the new development or that arises once development is complete. The guidance could make a specific recommendation that applicants take account of locally adopted waste plans and strategies and engage early with the relevant waste collection and disposal authorities, operators and the Environment Agency. Greater emphasis could also be placed on the need to consider and assess the impact of waste management on the wider environment and communities (with appropriate links to other topics in Section 5 of the draft NPS).
				Draft NPS including Exclusionary Criteria: Positive effects on waste and resources associated with this reasonable alternative are expected to be broadly similar to those identified in respect of the draft NPS above. It should be noted that the setting of clear parameters for siting which excludes specific environmental and cultural assets may indirectly help to avoid adverse impacts on these sites/assets associated with the management of wastes arising from geological disposal infrastructure. The adoption of exclusionary criteria may also help to protect natural resources present in designated areas (such as Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites). However, this is not considered to constitute a significant positive effect in the context of this objective.
				No NPS: Under this alternative, applications would be subject to the provisions of national planning policy and the EIA Regulations as well as a wide range of legislation at the European and national level on waste including the Waste Framework Directive. The environmental permitting regime also incorporates operational waste management requirements for certain activities. This policy and legislative framework are expected to help ensure that applicants consider the impacts of GDF-related development proposals on waste and resources, generating a positive effect on this objective. However, the absence of a clear statement regarding waste considerations and impacts on resource use (as proposed in the draft NPS) risks inconsistency in interpretation, particularly at a project level.
Decision Making	**+**	**+**	**+/?**	**Draft NPS:** The draft NPS states at paragraph 5.13.8 that the Secretary of State should "*consider the extent to which the applicant has proposed an effective system for managing hazardous and non-hazardous waste arising from the construction, operation and decommissioning of the proposed development. He should be satisfied that:* • *any such waste will be properly managed, both on-site and off-site;* • *the waste from the proposed development can be dealt with appropriately by the waste infrastructure which is, or is*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				likely to be, available. Such waste arising should not have an adverse effect on the capacity of existing waste management facilities to deal with other wastes in the area; • *adequate steps have been taken to minimise the volume of waste arising, and* • *adequate steps have been taken to minimise the volume of waste to be sent for disposal, considering what provides the best overall environmental outcome."* It is considered that the draft NPS provides a clear decision-making framework in relation to the consideration of waste. This is expected to help ensure that waste arisings associated with the construction, operation and closure of geological disposal infrastructure will be minimised and that reuse, recycling and recovery will be promoted. In consequence, the draft NPS has been assessed as having a positive effect on waste and resources. *Recommendations for Improvement* Consideration could be given to the inclusion of a specific reference to the extent to which the arrangements for the management of waste proposed are in accordance with the waste hierarchy in this section of the draft NPS. Reflecting National Planning Policy for Waste (2014), reference in this section could also be made to the need for the Secretary of State to consider impacts on sites and areas allocated for waste management and the integration of waste management facilities with the rest of a development. It is also considered that the guidance could be more definitive in respect of the circumstances in which the Secretary of State could refuse consent on the grounds of the management of waste and which could include, for example, concerns raised by the Environment Agency that remain unresolved. Finally, clearer direction could be provided with respect to the need for the Secretary of State to consider the impact of waste management activities on the environment and communities.
				Draft NPS including Exclusionary Criteria: Positive effects on waste and resources associated with this reasonable alternative are expected to be broadly similar to those identified in respect of the draft NPS above.
				No NPS: Under this alternative, applications would be subject to the provisions of national planning policy and the EIA Regulations as well as a wide range of legislation at the European and national level on waste including the Waste Framework Directive. The environmental permitting regime also incorporates operational waste management requirements for certain activities. This policy and legislative framework are expected to help ensure that decisions made by the Secretary of State take account of the impacts of GDF-related development proposals on waste and resources, generating a positive effect on this objective. However, the absence of a clear statement regarding waste considerations and impacts on resource use to be taken into account by the Secretary of State (as proposed in the draft NPS) risks inconsistency in interpretation, particularly at a project level.
Mitigation	**+/?**	**+/?**	**+/?**	**Draft NPS:** At paragraph 5.13.10, the draft NPS sets out that, where necessary, the Secretary of State should use requirements or obligations to ensure that appropriate measures for waste management are applied. It highlights that the Secretary of State may wish to include a requirement for the review and revision of waste management plans at reasonable intervals during the

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				lifetime, or specific phases, of the development. This would be expected to have a positive effect on this objective. However, as currently worded, it is considered that the draft NPS lacks specificity in terms of the suite of mitigation measures that could be implemented to promote the sustainable management of waste at key project stages. As noted above, there is currently no specific topic contained in Section 5 of the draft NPS concerning resources and, therefore, no explicit mitigation is identified in this regard. However, a number of other topics in Section 5, alongside the 'criteria for good design' detailed in Section 4.5 of the draft NPS, do identify potential mitigation measures. This is considered further below (see 'Other Sections of the draft NPS'). *Recommendations for Improvement* The mitigation could be revised to be more specific and clearly reflect the key project stages of site investigation, construction, operation and closure, as follows[323]: *Site Investigation* A range of wastes would be generated during surface-based site investigations, including drill cuttings, drilling fluids, test water and construction wastes. The Radioactive Waste Management Ltd (2016) Geological Disposal Generic Environmental Assessment report estimates that from a combined drilling of 25,000 m (from 20 deep boreholes) there would be up to 600 m^3 of drill cuttings (not the retrieved core), up to 1,800 m^3 of drilling fluid, up to 2,100 m^3 of test water and up to 3,000 m^3 of construction waste. Other waste types would include waste generated from machinery lubricants, oils and greases, excess cement from casing installations, fuels and component packaging. Some general office waste, organic canteen wastes, packaging and electrical products are also likely to be generated throughout the duration of the siting process. Depending on their type, wastes may be sent to landfill, recycled or re-used. Some waste (e.g. small amounts of laboratory waste) may be treated as hazardous waste in line with relevant waste regulations. Drill cuttings would be disposed of to landfill after all required testing and analysis was complete. Mitigation measures in this context could include: • Full consideration of waste issues in the GDF siting process. • During site-based investigations, implement waste minimisation and management best practices, in line with published guidelines and an environmental management plan incorporating a SWMP. • Consider materials usage and waste early and seek opportunities to design out waste generation. • Explore opportunities for beneficial re-use of drilling cuttings (e.g. re-use as secondary aggregate). • Consider commercial, technical and environmental factors.

[323] Derived from: Radioactive Waste Management Ltd (December 2016) *Geological Disposal: Generic Environmental Assessment*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• Explore opportunities to minimise the generation of waste and promote the application of and adherence to the waste management hierarchy locally through community investment. *Construction* The construction of a GDF would generate large amounts of construction wastes including: green waste, aggregates, soil and spoil; secondary wastes (such as concrete, gypsum and metals); tertiary wastes (including broken bricks/blocks, nails/bolts, worn tools, canisters, drums); and general office and domestic waste. Wastes may be sent to landfill, recycled or re-used (e.g. for landscaping or as aggregates for construction projects). Some of the waste may also be treated as hazardous waste and would need to be handled in compliance with relevant waste regulations. The most significant waste stream would be excavated rock. The Radioactive Waste Management Ltd (2016) Geological Disposal Generic Environmental Assessment report estimates that the following quantities of excavated materials could be generated over the lifetime of the project (using the upper inventory of Higher Activity Radioactive Waste (HAW) to be disposed of, although these estimates will be affected in particular by updates to the inventory for disposal): • Higher strength rock – 10.80 million m^3; • Lower strength sedimentary rock – 8.83 million m^3; and • Evaporite rock – 6.52 million m^3. Not all excavated material would necessarily become waste, as some will be used on site to form mounds (except evaporite rock), some will be used for backfill (higher strength rock only) and some may find a market for beneficial uses elsewhere. For all of the host rock types, if none of the surplus excavated rock could be re-used on or off-site for another purpose this would result in a significant waste stream and could have a significant impact on existing waste management infrastructure. In this context, additional mitigation measures (beyond those identified under site investigation) during this stage could include: • A new, construction-period environmental management plan(s) linked to an integrated waste management strategy. • Explore opportunities for the beneficial re-use of any surplus excavated rock at an early stage to maximise the likelihood of diverting the excavated rock/aggregates from landfill. For example, excavated rock could be exported via railhead for use as aggregates/construction material. There may also be opportunities for re-use of some excavated rock as hardcore, aggregate or for other purposes in the construction of the GDF surface facilities. • Implement waste minimisation and management best practices, in line with published guidelines. • Design the waste collection/management facilities at site to facilitate the separation and re-use/recycling of waste. *Operation* Construction of the Intermediate Level Waste (ILW)/Low Level Waste (LLW) vaults and High Level Waste (HLW)/Legacy Spent Fuel (SF) disposal tunnels would continue throughout the operational period with the principal waste generated being excavated rock. Other wastes similar to those identified for construction above may also continue to be generated. In consequence, mitigation measures would be the same as those already identified but could additionally include:

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• A new, operational-period environmental management plan incorporating a SWMP. • Periodic review of the environmental management plan. • Explore opportunities for beneficial/ sustainable reuse of surplus excavated rock removed from site to avoid disposal as waste. *Closure* The principal source of waste generation during this stage would be the decommissioning and demolition of surface facilities. A proportion of the waste materials may be classed as hazardous wastes, which would be disposed of in licensed facilities in accordance with appropriate regulatory requirements (as they stand at the time). Mitigation measures would be the same as for the phases above but would additionally include: • The integrated waste management strategy should consider the options for reuse or recycling of materials wherever possible, including the pre-closure audit to make the most of the opportunities available at that time. This could include supply of waste materials from a GDF site to other construction sites elsewhere. • Explore opportunities for beneficial / sustainable re-use of surplus materials to avoid disposal as waste.
				Draft NPS including Exclusionary Criteria: The specification of exclusionary criteria is unlikely to make a difference to the application of the mitigation and enhancement measures as set out for the draft NPS above, and as such the predicted effects are likely to be similar.
				No NPS: Appropriate mitigation measures will be considered by the competent authority in light of the proposals submitted. As such, mitigation measures will be applied but there is the risk that this is open to interpretation and thereby does not fully address an appropriate range of activities which are directly related to the scheme.
Other Sections of the Draft NPS Relevant to Waste and Resources	**1. Introduction** 1.1.3 There is an opportunity for the consideration of waste and resource use in a specific locality through the preparation of a local impact report submitted by a local authority in accordance with the Planning Act. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on waste and resource use as an issue, helping to ensure that consideration is given to the likely effects in a particular locality. 1.1.5 Consideration of the effects in terms of waste and resource use is reflected in the need to apply the draft NPS in the context of balancing adverse impacts and benefits. However, the net result of this balancing exercise could be uncertain. 1.1.7 The generic impacts considered in the draft NPS, along with the application of the draft NPS as a material consideration on a case by case basis, could result in uncertainty over what provisions will be applied in respect of the consideration of waste and resource use. Sections 1.1.14 and 1.1.15 outline the process by which the relevant independent statutory regulators assess the nuclear safety, security and environmental protection of the facility which is distinct from the application for development consent.			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	1.4 Consideration of deep boreholes investigations – the role and content of an ES, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of potential waste and resource use impacts, avoiding or reducing adverse impacts and providing appropriate mitigation measures where required. **1.5 Consideration of geological disposal facilities** – the spatial disposition of facilities and the timescale of development could affect waste and resources although the requirements for limiting cumulative negative impacts within safety and reasonable financial constraints should help to minimise impacts. The Environment Agency will regulate the environmental aspects of the GDF including, inter alia, operational waste management requirements for certain activities. Regulatory approval from the Environment Agency is not a prerequisite to the granting of development consent and therefore not required at the application stage, however the Secretary of State and the Examining Authority may wish to seek advice on the progress of appropriate environmental authorisations. **2. Government Policy on Management of Higher Activity Radioactive Waste** 2.2.6. The preference for disposal through a single site could help to reduce total waste generation and resource use given the potential for an approach involving the development of multiples sties to result in the duplication of supporting infrastructure. However, disposal through a single site may increase pressure on resources and waste management facilities in a specific area. 2.4.3 The technical strategy for implementation provides for the opportunity to consider waste and resource use as the process proceeds iteratively. **3. The Need for Geological Disposal Infrastructure** The principle of geological disposal of Higher Activity Radioactive Waste has already been established and is therefore not the subject of this AoS. However, by providing a clear framework for decisions relating to geological disposal infrastructure, the draft NPS could (indirectly) help to support the delivery of a GDF in a timely manner thereby helping to ensure the safe and secure management of the UK's Higher Activity Radioactive Waste in the long term. **4. Assessment Principles** **4.1 General principles of assessment** - the provisions of the Planning Act and the policies and protections set out in the draft NPS provide for a balanced consideration of impacts and benefits. The requirement for the identification of positive and adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for the consideration of waste and resource use associated with geological disposal infrastructure. **4.2 Environmental Impact Assessment** – the consideration of proposals within the EIA Regulations and the preparation of an ES (or environmental assessments) agreed by statutory agencies and specifying mitigation and enhancement measures will ensure that impacts in respect of waste and natural resources (if scoped into an EIA) are taken fully into account. **4.3 Habitats Regulations Assessment** – no direct relationship identified. **4.4 Alternatives** – the identification that reasonable alternatives will be required as part of scheme design and project planning should ensure that impacts in respect of waste and natural resources are taken into account. **4.5 Criteria for 'good design' for geological disposal infrastructure** – the construction, operation and closure of a GDF will require large quantities of materials. The Radioactive Waste Management Ltd (2016) Geological Disposal Generic Environmental Assessment Report estimates that, based on generic design work, the following materials and their quantities would be required over the whole life-cycle of a GDF: • Surface facilities concrete: between 41,791 – 44,779 tonnes. • Surface facilities steel: between 1,456-1,792 tonnes. • Surface facilities brickwork/blockwork: between 130-144 tonnes. • Surface facilities cladding: between 23,233-25,688 tonnes.			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal

- Underground concrete: 890,000 m^3 (not including shotcrete).
- Underground shotcrete: 1,200,000 m^3.
- Steel reinforcement: 3,000 tonnes.
- Rock bolts 5,000 tonnes required.

In addition, the emplacement of waste during the operational phase and associated backfilling and sealing would require the following:

- Bentonite – potentially between 0.66 and 4.4 million m^3, depending on rock type.
- Nirex Reference Vault Backfill – potentially around 1.7 million m^3 (higher strength rock only).
- Cementitious grout – potentially around 1.85 million m^3 (lower strength sedimentary rock only).
- Magnesium oxide – 6,930 m^3 (evaporite rock only).
- Crushed rock– 1.27 million m^3 (evaporite rock only).

GDF-related development would also result in the consumption of water (considered under the 'Water'' topic of this AoS Report) and energy use (considered under the 'Climatic Factors' topic in the context of CO_2 emissions).

The 2016 Geological Disposal Generic Environmental Assessment report highlights that whilst these quantities initially appear large, in the context of the capacity of relevant UK/international supply and the fact that the demand is spread over many years, the impact would not be significant. Further, the requirement in the draft NPS for applicants to include design as an integral consideration from the outset of a proposal is expected to help ensure that measures are adopted to enable the sustainable management of waste (in accordance with the waste hierarchy) and minimise resource use, thereby generating positive effects in respect of this objective. In this regard, paragraph 4.5.2 states that "*Applying 'good design' to geological disposal projects should produce sustainable infrastructure…efficient in the use of natural resources and energy used in their construction*". There is the potential, however, for the draft NPS to identify more specific measures to reduce resource use including, for example:

- Full consideration of resource use in GDF siting process to allow for resource efficiency opportunities to be investigated.
- Design all site buildings and operations to high standards of energy and water efficiency, with reference to BREEAM or other relevant published standards.
- Maximise the use of renewable energy sources.
- Use non-potable water for construction operations.
- Reduce wastage through effective procurement.
- Use/specify materials with high recycled content and inherently low embedded carbon content and responsibly sourced.
- Make best use of existing infrastructure.
- Design the GDF to maximise the potential for re-use of excavated rock in backfill in place of imported and specialist materials such as bentonite.
- Plan closure to maximise the potential for re-use of excavated rock in backfill in place of imported and specialist materials such as bentonite
- Apply an appropriate environmental management plan.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	• Establish recording and monitoring procedure for use of resources and set appropriate targets for performance (including targets for use of renewable energy). • Explore opportunities to promote the efficient use of resources to GDF staff. • Explore opportunities to promote the efficient use of resources locally through community investment. Reflecting the requirements of the EIA Directive (as amended), applicants should be expected to set out the estimated energy demand and energy use and the nature and quantity of the materials and natural resources (including water, land, soil and biodiversity) required. **4.6 Climate Change Adaptation** – no direct relationship identified. **4.7 Pollution Control and other Environmental Regulatory Regimes** – as set out at paragraph 4.7.7 of the draft NPS, both boreholes and a GDF will be subject to the Environmental Permitting regime, which also incorporates operational waste management requirements for certain activities. The draft NSP sets out that the Examining Authority may wish to consult the regulator on any management plans that would be included in an Environmental Permit application and encourage early pre-application discussions between the applicant and the relevant regulator. This is expected to help ensure that waste and resource use issues are fully taken into account. **4.8 Common Law Nuisance and Statutory Nuisance** – no direct relationship identified. **4.9 Safety** – no direct relationship identified. **4.10 Health** – no direct relationship identified. **4.11 Security Considerations** – no direct relationship identified. **Section 5 (other topics)** – it should be noted that there are links between waste and resource and other topics contained in Section 5 of the draft NPS including, in particular, those related to climatic factors, land use and water quality (including surface and ground water quality and availability). Taken together, it is anticipated that these topics will generate further positive effects in respect of the waste and resource use.			
Summary Appraisal of Likely Significant Effects	**+**	**+**	**+/?**	**Draft NPS:** The development of geological disposal infrastructure will require significant volumes of resources including concrete and steel as well as natural resources such as water. During the lifetime of a GDF, and particularly at construction, large quantities of waste will also be generated. In this context, the draft NPS promotes good design as an integral consideration from the outset of a proposal which is expected to help encourage the sustainable use of natural resources and material assets, including through the re-use and recycling of recovered components and materials. It is also considered that the draft NPS provides a clear framework for applicants and the Secretary of State in relation to the consideration of waste that will help to ensure that waste arisings associated with the construction, operation and closure of geological disposal infrastructure are minimised and that reuse, recycling and recovery are promoted. Overall, the draft NPS has been assessed as having a positive effect on this objective, although as currently drafted it is considered that it lacks some specificity in terms of the suite of mitigation measures that could be implemented to address effects arising from GDF-related development and promote the sustainable management of waste and resource use at key project stages.
				Draft NPS including Exclusionary Criteria: Positive effects on waste and resources associated with this reasonable alternative are expected to be broadly similar to those identified in respect of the draft NPS above. It should be noted that the setting of clear parameters for siting which excludes specific environmental and cultural assets may indirectly help to avoid adverse impacts on these sites/assets associated with the management of wastes arising from geological disposal

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				infrastructure. The adoption of exclusionary criteria may also help to protect natural resources present in designated areas (such as SACs, SPAs and Ramsar sites). However, this is not considered to constitute a significant positive effect in the context of this objective.
				No NPS: Under this alternative, applications would be subject to the provisions of national planning policy and the EIA Regulations as well as a wide range of legislation at the European and national level on waste including the Waste Framework Directive. The environmental permitting regime also incorporates operational waste management requirements for certain activities. This policy and legislative framework are expected to help ensure that decisions made by the Secretary of State take account of the impacts of GDF-related development proposals on waste and resources, generating a positive effect on this objective. However, the absence of a clear statement regarding waste considerations and impacts on resource use to be taken into account by the applicant and the Secretary of State (as proposed in the draft NPS) risks inconsistency in interpretation, particularly at a project level.
Summary of Recommending Mitigation and Enhancement	Whilst the draft NPS is considered to provide a positive framework that will encourage the sustainable management of waste and resource use, a number of enhancement measures have been identified. In particular, it is considered that the draft NPS could provide: • guidance with respect to the assessment of waste and resources as part of any ES (as required); • greater specificity in terms of the suite of mitigation measures that could be implemented to address effects associated with GDF-related development and to promote the sustainable management of waste and resource use at key project stages; and • more definitive guidance in respect of the circumstance(s) in which the Secretary of State could refuse consent on the grounds of the management of waste.			

11. Traffic and Transport

Introduction

This section presents the overview of plans, programmes and baseline information for the appraisal of sustainability of the National Policy Statement for Geological Disposal Infrastructure and reasonable alternatives in respect of traffic and transport. Within this context, the definitions of traffic and transport are provided below:

- Traffic - the aggregation of pedestrians or vehicles coming to or leaving from a particular locality during a defined period of time.
- Transport - the movement of people and goods from one place to another. Transport is performed by various modes, such as air, rail, road and water.

There are links between the traffic and transport topic and other topics in the Appraisal of Sustainability (AoS) including air quality, noise, climatic factors and population, economics and skills.

Review of Plans and Programmes

A part of the focus of plans and programmes on transport is on both maintaining a free-flowing transport system, particularly with respect to roads, and on promoting sustainable modes of transport. There are also a number of plans and programmes that identify and prescribe the approach and procedures necessary for the transportation of dangerous goods, including radioactive materials, by various modes of transport.

International/European

In relation to the safe transportation of potentially dangerous goods, the ***International Maritime Dangerous Goods Code (last amended 2016)*** sets out a uniform code for the transport of dangerous goods by sea covering such matters as packing, container traffic and stowage, with particular reference to the segregation of incompatible substances. The Code regulates sea transport of hazardous materials to ensure the safe transportation of dangerous goods and to prevent marine pollution. The ***European Agreement Concerning the International Carriage of Dangerous Goods by Road*** (ECE/TRANS/257, Vol. I and II (ADR 2017)) sets out high level aims, duties and provisions for the carriage of dangerous goods in Europe.

Specifically in relation to the transport of radioactive materials, the International Atomic Energy Agency's (IAEA) ***Regulations for the Safe Transport of Radioactive Material (SSR-6) (2012)*** (commonly known as 'the IAEA Transport Regulations') sets out the regulations which apply to the transport of radioactive material by all modes of transport on land, water or in the air, including transport that is incidental to the use of the radioactive material. The main objective of the ***Shipments of Radioactive Waste and Spent Fuel Directive (2006/117/Euratom)*** is to establish a system of control and prior authorisation for shipments of radioactive waste, to protect the health of workers and the general public and to avoid illicit traffic of such materials.

UK

The ***Transport Act 2000*** aimed to give effect to the UK Government's strategy for an integrated transport policy set out in the White Paper entitled ***A New Deal for Transport: Better for Everyone (1998)***[324]. The Act introduced a number of reforms to local transport planning and delivery, including the requirement for all local transport authorities in England, outside of London, to produce a local transport plan. It also granted new powers for local authorities to enter into quality partnerships with bus operators and to introduce road user charging schemes and workplace parking levies.

The ***Local Transport Act 2008*** empowers local authorities to take appropriate steps to meet local transport needs in the light of local circumstances.

The ***Road Safety Act 2006*** makes provision about road traffic, registration plates, vehicle and driver information, hackney carriages and private hire vehicles, and trunk road picnic areas. The ***Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (as amended)*** (SI 2009/1348) sets out measures to regulate the carriage of dangerous goods by road and rail in Great Britain.

The transport of dangerous goods by air is governed by the ***Air Navigation (Dangerous Goods) Regulations 2002 (as amended)*** (SI 2002/2786). The transport of dangerous goods by sea, meanwhile, is governed by the ***Merchant Shipping (Dangerous Goods and Marine Pollutant) Regulations 1997*** (SI 1997/2367) and the ***Merchant Shipping (Vessel Traffic Monitoring and Reporting Requirements) Regulations 2004*** (SI 2004/2110). Part 3 of the ***Energy Act 2013*** and the ***Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations (CDG) 2009*** are also of relevance to the transportation of radioactive materials.

The ***NDA Geological Disposal Transport Safety Strategy (2014)*** presents the NDA's strategy and outlines the documents to be prepared for understanding, assessing and ensuring the safety of transport activities associated with the lifecycle of a GDF. The Strategy is aligned with the IAEA Transport Regulations (2012) and sets out the following transport-specific priorities:

- responsibility for demonstrating transport safety; and
- assessment of all safety impacts of transport.

England

Cutting Carbon, Creating Growth: Making Sustainable Local Transport Happen White Paper (Department for Transport (DfT), 2011)) sets out a vision for a transport system that is an engine for economic growth and also greener and safer and improves quality of life in communities. The White Paper sets out the Government's priority for local transport which is to encourage sustainable local travel and economic growth by making public transport and cycling and walking more attractive and effective, promoting lower carbon transport and tackling local road congestion.

The ***National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2012)*** aims to integrate planning and transport to promote more sustainable transport choices, enhance accessibility to jobs, shopping, leisure facilities and

[324] Department for Transport (1998*) A new deal for transport: better for everyone* - white paper. Available online at: http://webarchive.nationalarchives.gov.uk/+/http:/www.dft.gov.uk/about/strategy/whitepapers/previous/anewdealfortransportbetterfo5695

services by public transport, walking and cycling and to reduce the need to travel, especially by car.

The ***National Networks National Policy Statement (DfT, 2014)*** sets out the need for development of road, rail and strategic rail freight interchange projects on the national networks and the policy against which decisions on major road and rail projects will be made.

The ***National Policy Statement for Ports (DfT, 2012)*** provides the framework for decisions on proposals for new port development. The NPS sets out that the Government seeks to:

- encourage sustainable port development to cater for long-term forecast growth in volumes of imports and exports by sea with a competitive and efficient port industry capable of meeting the needs of importers and exporters cost effectively and in a timely manner, thus contributing to long-term economic growth and prosperity;
- allow judgments about when and where new developments might be proposed to be made on the basis of commercial factors by the port industry or port developers operating within a free market environment; and
- ensure all proposed developments satisfy the relevant legal, environmental and social constraints and objectives, including those in the relevant European Directives and corresponding national regulations.

Scotland

First published in 2006 and refreshed in January 2016, ***Scotland's National Transport Strategy (2006)*** aims to connect people to jobs, education, services and recreation. The refreshed strategy reaffirms the continued validity of the three key strategic outcomes identified in the original strategy, namely:

- improve journey times and connections between cities and towns and global markets to tackle congestion and provide access to key markets;
- reduce emissions to tackle climate change; and
- improve quality, accessibility and affordability of transport, to give people the choice of transport and alternatives to the car.

The ***Scottish Planning Policy (2014)*** seeks to promote sustainable transport and active travel and states that the planning system should support patterns of development which optimise the use of existing infrastructure, reduce the need to travel, provide safe and convenient opportunities for walking and cycling for both active travel and recreation, enable the integration of transport modes and facilitate freight movement by rail or water.

One of the visions of ***Scotland's Third National Planning Framework (NPF3) (2014)*** is that of a connected place and where the whole country has access to high-speed fixed and mobile digital networks. It sets out that better use of the existing infrastructure should be made, and that there should be improved digital and international transport links to facilitate growth and an inclusive society. The long-term development strategy provided by NPF3 complements other strategic documents and is important in delivering the Scottish Government's aspiration for sustainable economic growth. In this context, the NPF identifies the following spatial priorities for change:

- cities will be better connected and provide a gateway to the rest of the world;
- rural areas will be more accessible; and

- we will reduce the disadvantage of distance for our coastal and island communities.

Planning Advice Note: PAN 75 – Planning for Transport (2005) aims to create greater awareness of how linkages between planning and transport can be managed. It highlights the roles of different bodies and professions in the process and points to other sources of information.

Wales

One Wales: Connecting the Nation (2008) is the Welsh strategy for transport. It contains 17 long-term social, economic and environment outcomes for transport in Wales, and these are set out under five key themes which include:

- reducing greenhouse gas emissions and other environmental impacts;
- improving public transport and better integration between modes;
- improving links and access between key settlements and sites across Wales and strategically important all-Wales links;
- enhancing international connectivity; and
- increasing safety and security.

The ***National Transport Plan (2010)*** sets out ten proposals to provide people with a range of transport options, including to continue to establish sustainable travel centres across Wales, increasing healthy and sustainable travel choices and improving local bus services. The ***National Transport Finance Plan (2015)*** identifies the financing and delivery timetables for transport schemes undertaken by the Welsh government. This includes maintenance and safety schemes alongside new infrastructure.

Planning Policy Wales (Edition 9) (2016) identifies several objectives including promoting sustainable transport for freight and commerce, supporting sustainable transport options in rural areas, supporting necessary infrastructure improvements and ensuring that, as far as possible, transport infrastructure does not contribute to land take, urban sprawl or neighbourhood severance.

Technical Advice Note (TAN 18) on Transport and the Transport Strategy for Wales (2008) sets out key planning policy objectives for transport. These include promoting resource and travel efficient settlement patterns, ensuring new development is located where there is or will be good access by public transport, walking and cycling and managing parking provision.

Overview of the Baseline

UK

The following sub-sections review the current situation on the UK's transport networks.

Road

The roads and streets of the UK are an important resource for commuting, private journeys and the transportation of freight. The UK has a road infrastructure network of 396 thousand kilometres, the majority of which is made up of minor roads (87.3%)[325].

Between 195 and 2015, the distance travelled by motor vehicles increased by 18.6%. In 2015, a total of 509.7 billion kilometres were travelled by all motor vehicles in the UK, an increase of 11.8 billion miles since 2013. In Great Britain, overall there has been a steady increase in domestic road freight with 73% of freight goods being moved by road in 2014. Lorry traffic saw the largest year-on-year increase since the 1980s, growing by 3.7% from 2014, whilst van traffic continued to grow more quickly than any other vehicle type, rising 4.2% from 2014 levels[326].

In 2015, the number of reported road fatalities decreased by 3% to 1,730 compared to 2014. This is the second lowest annual total on record after 2013. There were 45 per cent fewer fatalities in 2015 than a decade earlier in 2006[327].

Rail

Over the last two decades there has been substantial growth in rail usage, and rail passenger journeys are now at their highest level since the 1920s. An average of 4.7 million journeys per day are made in Great Britain. The majority of growth has been in the London and the South East, and 64% of journeys either start or end in London.

Around 12% of all freight moved in Great Britain was by rail in 2014. In 2015-16, freight moved by rail was 18 billion net tonne km, down 20% from 2014-15. This decrease was mainly due to a decline in the amount of coal moved, which has fallen substantially (72%) since 2005-06.[328].

Aviation

There are 58 airports in the UK, with Heathrow being the largest and accounting for twice as many passengers and air transport movements as that next largest airport, Gatwick[329]. Air traffic in the UK has been rising steadily. In 1953 there were 195,000 air traffic movements, by 2015 this figure was 2,111,000. In this time, both the number of passengers flying and the amount of freight transported has risen dramatically to 251.4 million passengers and 2.3 million tonnes respectively[330].

Water

The UK has 51 Major Ports, defined as ports with cargo volumes of at least 1 million tonnes annually, including Sullom Voe; Forth; Tees and Hartlepool; Hull; Grimsby and Immingham; Felixstowe; Harwich; London; Ramsgate; Dover; Portsmouth; Southampton; Milford Haven; Holyhead; and Liverpool. Overall total freight tonnage declined by 1 per cent in 2015 with 496.7 million tonnes being handled by UK ports in 2015. Whilst tonnage fell marginally,

[325] Department for Transport (2016) *Road Lengths in Great Britain 2015 Report*. Available online at: https://www.gov.uk/government/statistics/road-lengths-in-great-britain-2015
[326] Department for Transport (2016) *Traffic Estimates: Great Britain 2015.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/524261/annual-road-traffic-estimates-2015.pdf
[327] Department for Transport (2016) *Reported Road Casualties Great Britain: 2015 Annual Report*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/590561/rail-trends-factsheet-2016-revised.pdf
[328] Department for Transport (2017) *Rail Trends Factsheet*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/590561/rail-trends-factsheet-2016-revised.pdf
[329] Department for Transport (2016) *Transport Statistics Great Britain 2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/489894/tsgb-2015.pdf
[330] Department for Transport (2016) *Air traffic at UK airports (AVI01)*. Available online at: https://www.gov.uk/government/statistical-data-sets/avi01-traffic-passenger-numbers-mode-of-travel-to-airport

reflecting reduced demand for coal and ores, changes in steel production, and lower dependency on food imports, unitised traffic experienced a third consecutive year of growth. Liquid bulk was the largest of the main cargo types with 194.4 million tonnes being handled at UK major ports, accounting for 40 per cent of all major port traffic.[331,332].

Movement of Radioactive Materials

At least half a million packages of radioactive materials are shipped within the UK each year. Transport of radioactive materials is associated with a number of activities and industries, for example electricity generation, healthcare, university research and education, with the nuclear industry making up only a small proportion of these movements. Transport is seen as a key issue for local stakeholders in respect of decisions about the management of wastes from nuclear sites. In principle, there is the potential for the following effects:

- severance to routes used by pedestrians/cyclists/equestrians and loss of amenity;
- community severance;
- severance of habitats and wildlife commuting/foraging/migration routes;
- driver and pedestrian delay and safety implications;
- transportation of mud and pollutants off site on vehicle wheels; and
- increases in noise and/or air pollution and the emission of greenhouse gases[333].

England

Road

England has a road infrastructure network of approximately 303,000 km (as at 2015), of which 12% comprises major roads[334]. The average speed on local 'A' roads in England during the weekday morning peak in the year ending December 2015 was 23.4 mph. This is a 0.7% decrease on the year ending September 2015[335].

Over the last two decades the rate of car traffic growth has slowed. For an average person, car use fell throughout the 2000s, but this was partially offset by an increase in population using the roads. Van traffic has grown faster than car traffic on all types of road in recent years. HGV vehicles are travelling less distance, but carrying more goods since the 1990s, owing to a shift away from using smaller HGV vehicles towards larger vehicles or vans. HGV traffic has not yet returned to pre-recession levels. Recent trends show a resumption of traffic growth after the recession. Growth has been strongest on the SRN and for van traffic across all roads[336].

[331] Department for Transport (2016) *UK Port Freight Statistics: 2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/555338/port-freight-statistics-2015.pdf
[332] Department for Transport (2015) *Domestic Waterborne Freight, 2014*. Available online at: https://www.gov.uk/government/statistics/domestic-waterborne-freight-2014
[333] RWM (2016) *Geological Disposal Generic Environmental Assessment*. Available online at: https://rwm.nda.gov.uk/publication/geological-disposal-generic-environmental-assessment/
[334] Department for Transport (2016) *Road Lengths in Great Britain 2015 Report.* Available online at: https://www.gov.uk/government/statistics/road-lengths-in-great-britain-2015
[335] Department for Transport (2016) *Congestion on local 'A' roads, England: October to December 2015 Report.* Available online at: https://www.gov.uk/government/statistics/congestion-on-local-a-roads-england-october-to-december-2015
[336] Department for Transport (2016) *Road use statistics Great Britain*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/514912/road-use-statistics.pdf

Rail[337]

In 2014/15, 70% of Great Britain rail journeys were made with London and South East operators.

Aviation[338]

Heathrow is the busiest airport in the UK, followed by Gatwick and Manchester, with approximately 75 million passengers in 2015[339]. The other major airports in London are Gatwick, Luton, Stansted and London City, and other major airports in England include Birmingham, Bristol, Newcastle, East Midlands International and Liverpool (John Lennon).

Water

Grimsby and Immingham remained England and the UK's busiest port in terms of tonnage, handling 12 per cent of the UK market in 2015 with 59.1 million tonnes of goods. Grimsby and Immingham overtook London as the busiest port in 2000. It also accounted for the largest share of the UK's dry bulk traffic at 18 per cent (19.1 million tonnes). However, dry bulk tonnage at this port has decreased by 10 per cent compared to the previous year[340]. In 2015, goods moved by domestic water transport accounted for 15% of total domestic freight transport in the UK.

Modes of Transport

The 2011 Census highlighted that the majority people in England travelled to work by car. The breakdown of methods of travel to work is as follows[341]:

- working mainly at or from home – 3.5 % (1,349,568 persons);
- underground, metro, light rail, tram – 2.6% (1,027,625 persons);
- train – 3.5% (1,343,684 persons);
- bus, minibus or coach – 4.9% (1,886,539 persons);
- taxi – 0.3% (131.465 persons);
- motorcycle, scooter or moped – 0.5% (206,550 persons);
- driving a car or van – 36.9% (14,345,882 persons);
- passenger in a car or van -3.3% (1,264,553 persons);
- bicycle – 1.9% (742,675 persons);
- walking – 6.9% (2,701,453 persons);
- other method of travel to work – 0.4% (162,727 persons); and

[337] Department for Transport (2016) *Rail passenger numbers and crowding on weekdays in major cities in England and Wales: 2015.* Available online at*:* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/541587/rail-passengers-crowding-2015.pdf
[338] Department for Transport (2016) *Air traffic at UK airports*. Available online at https://www.gov.uk/government/statistical-data-sets/avi01-traffic-passenger-numbers-mode-of-travel-to-airport
[339] CAA (2016) *Summary of Activity at Reporting Airports 2015*. Available online at http://www.caa.co.uk/uploadedFiles/CAA/Content/Standard_Content/Data_and_analysis/Datasets/Airport_stats/Airport_data_2015/Table_02_2_Summary_Of_Activity_at_UK_Airports_2015.pdf
[340] Department for Transport (2016) *UK Port Freight Statistics: 2015.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/555338/port-freight-statistics-2015.pdf
[341] ONS (2011) *Method of Travel to Work in England and Wales – 2011.* Available online at: http://www.ons.gov.uk/ons/rel/census/2011-census-analysis/method-of-travel-to-work-in-england-and-wales/sty-method-of-travel-to-work.html

- not in employment 35.3% (13,718,653 persons).

UK Census data also indicates that the average distance travelled to work in England and Wales increased from 13.4km in 2011 to 15.0km in 2011[342].

Scotland

Road

There are 56,092 km of road in Scotland as of 2015. Of this, 6.4% (3,578 km) is Trunk road, which the Scottish Ministers are responsible for managing, whilst the remaining 52,514 km are managed by Local Authorities. There were 601 km of motorways, 775 km of dual carriageways and 27,604 km of single carriageway in Scotland in 2015[343].

Rail

There were 93.2 million passengers carried by ScotRail in 2015/16, an increase of 34% since 2005/6. As of 2015/2016 there were 358 stations and 2,819 km of rail network in Scotland[344].

Aviation

There were 25.5 million air passengers at Scottish airports in 2015. Three quarters travel to or from Edinburgh or Glasgow. A total of 56 thousand tonnes of freight were carried by air in 2015[345].

Water

There were 44 million tonnes of freight lifted by water transport in Scotland in 2015 (around a quarter of freight lifted in Scotland, including exports). There was a total of 7.8 million passengers and 2.7 million vehicles carried on ferry routes within Scotland in 2015. There were 1.7 million passengers and 0.4 million vehicles carried between Scotland and Northern Ireland and 43,000 vehicles carried between Scotland and Europe in 2015[346].

Modes of Transport

According to the 2011 Census results[347] of the 2.1 million 16 to 74 year olds in employment (excluding full-time students) who travel to work, 63 per cent (1.3 million) drove a car or van, an increase from 59 per cent in 2001. The next most common methods of transport, both at 11 per cent, were travelling by bus, minibus or coach (241,000) and on foot (238,000). The proportions travelling by bus and on foot had both decreased slightly from 12 per cent in 2001.

[342] ONS(2014) *2011 Census Analysis - Distance Travelled to Work.* Available online at: http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/dcp171776_357812.pdf
[343] Transport Scotland (2016) *Scottish Transport Statistics No 53 2016 Edition Chapter 4: Road Network.* Available online at: https://www.transport.gov.scot/publication/scottish-transport-statistics-no-35-2016-edition/SCT01171871341-07
[344] Transport Scotland (2016) *Scottish Transport Statistics No 35 2016 Edition Chapter 7: Rail Services.* Available online at: https://www.transport.gov.scot/publication/scottish-transport-statistics-no-35-2016-edition/SCT01171871341-10
[345] Transport Scotland (2016) *Scottish Transport Statistics No 35 2016 Edition Chapter 8: Air Transport.* Available online at: https://www.transport.gov.scot/publication/scottish-transport-statistics-no-35-2016-edition/SCT01171871341-11
[346] Transport Scotland (2016) *Scottish Transport Statistics No 35: 2016 Edition Chapter 9: Water Transport*. Available online at: http://www.transport.gov.scot/statistics/j357783-12.htm
[347] Scotland's Census (2013) Census 2011: Key results on Households and Families, and Method of Travel to Work or Study in Scotland - Release 2C. Available online at: http://www.scotlandscensus.gov.uk/news/census-2011-key-results-households-and-families-and-method-travel-work-or-study-scotland

Wales

Road
The total road length in Wales in 2015-16 was 34,642 km. Unclassified minor surfaced roads contribute approximately half the total road length in Wales[348].

Rail
The numbers of rail passenger journeys in Wales have been increasing over the last decade. There were 30.3 million rail passenger journeys which either started or ended in Wales in 2015-16, an increase of 3.4 per cent when compared to the previous year. Over two-thirds (68 per cent) of these journeys were within Wales. Rail passenger journeys within Wales have increased annually with approximately 20.7 million journeys reported in 2015-16 which is a 3.7 per cent increase on the 2014-15 figures[349].

Aviation
The total number of passengers using Cardiff International Airport increased by nearly 14 per cent between 2014 and 2015, to over 1.15 million. During 2015 there were 24 domestic routes and 73 international routes that operated out of Cardiff Airport. There were just over 15,000 commercial aircraft movements at Cardiff International Airport. There were just under 10,000 non-commercial aircraft movements making just over 25,000 in total[350].

Water
In Wales during 2015 total freight traffic through Welsh ports was 56.4 million tonnes (Mt). Of this, 40.4 Mt were goods inwards and 15.9 Mt were goods outwards. Welsh ports accounted for 11 per cent of the total United Kingdom (UK) port traffic of 496.7 Mt.

Summary of Existing Problems Relevant to the Geological Disposal NPS

The following existing problems for traffic and transport have been identified:

- There are areas of the UK's transport network which are stretched beyond their capacity at peak times.
- Increasing levels of congestion are being experienced on the UK's road network;
- There is a need for investment in transportation infrastructure to meet future demand and support economic growth.
- There is a need to reduce the need to travel and facilitate a shift towards more sustainable modes of transport.
- The transport of radiological materials by road and rail in the UK is controlled by the Office for Nuclear Regulation and the Department for Transport. Nevertheless,

[348] Welsh Government (2017) *Road Lengths and Conditions 2014-15.* Available online at: http://gov.wales/statistics-and-research/road-lengths-conditions/?lang=en

[349] Welsh Government (2017) *Rail Transport*. Available online at: http://gov.wales/statistics-and-research/rail-transport/?lang=en

[350] Welsh Government (2016) *Air Transport.* Available online at: http://gov.wales/statistics-and-research/air-travel/?lang=en

there is a need to ensure the safe transportation of such materials and minimise adverse effects of transport movements on local communities.

Likely Evolution of the Baseline

UK

Road

Between 1995 and 2015, the distance travelled by motor vehicles increased by 18.6%. In 2015, a total of 316.7 billion miles were travelled by all motor vehicles in the UK, an increase of 7.3 billion miles since 2013[351].

England's road traffic is expected to increase by between 19 - 55% above 2010 levels by 2040. Whilst new technologies will provide some relief through better use of network capacity, more highly automated vehicles may also be part of the problem by stimulating demand[352].

Rail

The ***National Policy Statement for National Networks (Department for Transport, 2014)***[353] highlights that passenger demand is predicted to continue to grow significantly, by 50.1% by 2033 with long distance rail passenger travel increasing by 63.8%. Total rail freight, meanwhile, is forecast to grow by 3% annually to 2043.

The All-Party Parliamentary Group for High-Speed Rail's Report of the Inquiry into Britain's Rail Capacity highlights that if the current growth rate of demand continued for a sustained period, current infrastructure would be inadequate and incremental upgrades such as those suggested by Rail Package 2 (RP2) and 51m's 'Optimised Alternative' would be insufficient to accommodate the demand. It states that, given recent passenger growth and the country's overall economic and transport strategy, the risks from under providing rail capacity seem higher than the risks of overprovision. In this context, the UK Government has identified a need for development of the national rail network at the strategic level including the development of strategic rail freight interchanges and new high speed lines.

Aviation

Demand for air travel is forecast to increase within the range of 1% - 3% a year up to 2050, compared to historical growth rates of 5% a year over the last 40 years. The slowdown in growth rates in the future reflects the anticipation of market maturity across different passenger markets and a projected end to the long-term decline in average fares seen in the last two decades[354].

The central forecast from the 2013 analysis, taking into account the impact of capacity constraints, is for passenger numbers at UK airports to increase from 219 million passengers in 2011 to 315 million in 2030 and 445 million by 2050. This is an increase of 225 million passengers over the next 40 years compared to an increase of 185 million since 1970. The

[351] Department for Transport (2016) *Traffic Estimates: Great Britain 2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/524261/annual-road-traffic-estimates-2015.pdf
[352] Reese Jeffrys (2016) *A major road network for England*. Available online at: http://www.futureroadsengland.org/
[353] Department for Transport (2014) *National Policy Statement for National Networks*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf
[354] Department for Transport (2013) *UK Aviation Forecasts.* Available online at: https://www.gov.uk/government/publications/uk-aviation-forecasts-2013

major south east airports are forecast to be full by 2030. However, there is a range around this projection and they could be full as soon as 2025 or as late as 2040. Heathrow remains full across all the demand cases considered by the DfT.

Water

In their assessment of future port demand, MDS Transmodal identified three forecasting scenarios for unitised traffic. These can be summarised as:

- Central Forecast: import growth dictates the overall growth of unit loads moving through the ports because those units will be 're-exported' whether loaded or empty. Import volumes are based upon the evidence of long run trends and relationships based upon GDP growth and exchange rate change, independently of trends in export growth. The implication is that export volumes will grow to meet any long run balance of payments deficits that might emerge.
- Low Case: growth in imports implied in the Central Forecast inhibited by the slower rate of growth of unit load exports over the last 5 years, implying that for imports to grow faster would lead to an unacceptable long run balance of payments deficit.
- High Case: growth in imports based upon the higher rates of unit load import growth over the last 5 years, implying that there will be a rapid growth in exports of goods and (particularly) services to avoid a long run balance of payments deficit[355].

The overall conclusion is that between 2004 and 2030 container traffic is expected to grow by 178% & 112% with regard to TEU (Twenty-foot equivalent) and HGV (Heavy Goods Vehicle) respectively. Bulk traffics are forecast to grow by just 8% overall. Total port tonnes for the UK are forecast to grow by 37%. Unit load cargoes are forecast to grow from about 27% of total UK port tonnes (including Eurotunnel) in 2004 to about 43% in 2030.

England

The latest forecasts conducted by the DfT predict that compared to the 2010 baseline (and under a central scenario), road traffic will between 19% and 55% higher by 2040. Cars are the dominant mode of road transport and are forecast to remain so in spite of a slight reduction in the proportion of total traffic they make. Cars made up 80% of traffic miles in 2010 and are forecast to make up between 73% and 80% of traffic miles in 2040, whereas light goods vehicles (LGVs) made up 14% in 2010 and this is forecast to be in the range 15% to 20% in 2040. HGVs comprise 6% of total traffic in 2010 and this is forecast to be in the range of 4% to 6% in 2040[356].

Scotland

Trends in Scotland are expected to mirror the broader UK, with a continuing increase in the total distance travelled by car and an increase in traffic congestion. Rail and air passenger numbers are also expected to continue to increase[357].

[355] MDS Transmodal Ltd (2006) UK Port demand forecasts to 2030. Available online at: http://webarchive.nationalarchives.gov.uk/+/http:/www.dft.gov.uk/consultations/archive/2006/ppr/ukportdemandforecaststo2030.pdf
[356] Department for Transport (2015) *Road Traffic Forecasts 2015.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411471/road-traffic-forecasts-2015.pdf]
[357] Transport Scotland (2017) Transport Statistics. Available online at: https://www.transport.gov.scot/our-approach/statistics/

Wales

Motor traffic in Wales peaked in 2015 at 28.4 billion vehicle kilometres, which is 1.5 per cent higher than the previous peak in 2007 and represents a 1.8 per cent increase on 2014. Road traffic would therefore be expected to continue to increase. Rail journeys are increasing by 3-4% year on year and would be expected to continue to increase[358].

Assessing Significance

The objectives and guide questions related to traffic and transport which have been identified for use in the appraisal of the effects of Geological Disposal Infrastructure NPS proposals are set out in **Table 11.1**, together with reasons for their selection.

Table 11.1 Approach to Assessing the Effects of the Geological Disposal Infrastructure NPS on Traffic and Transport

Objective/Guide Question	Reasoning
Objective: To minimise the volume of traffic and promote more sustainable transport choices.	Whilst traffic and transport is not specifically referred to in the SEA Directive (2001/42/EC), the issue is a significant one in the case of the GDF given the scale, duration and extent of construction, operation, decommissioning and closure.
Will the Geological Disposal Infrastructure NPS help to minimise traffic volumes?	Traffic, comprising heavy goods vehicles, passenger vehicles and trains can have a significant influence over noise, air quality, climate change, wildlife habitats and quality of life of communities in the vicinity of operations. The control of traffic volumes will help to minimise these effects.
Will the Geological Disposal Infrastructure NPS help to minimise the direct effects of transport such as noise and vibration, severance[1] of communities and wildlife habitats and safety concerns?	Minimising the direct effectis of traffic and transport on people and the environment is a key aim of national planning policy, and by extension issues such as human health in the SEA Directive. As such, these effects should be taken into consideration in the planning and management of traffic associated with implementing the NPS.
Will the Geological Disposal Infrastructure NPS encourage alternative and sustainable means of transporting freight, waste and minerals, where possible?	The development and use of sustainable transport is a major theme in national planning policy and as such, transport substitution (for example road to rail) wherever possible is encouraged, as well as trip minimisation. In turn this will help to meet air quality targets set locally, nationally and internationally.

[1] Community severance is the separation of communities by development such as roads, railways and pipelines. It can be the consequence of the cumulative impact of linear infrastructure on the perceptions, behaviour, and wellbeing of people who use the surrounding areas.

Table 11.2 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the traffic and transport objective.

Table 11.2 Illustrative Guidance for the Assessment of Significance for Traffic and Transport

[358] Welsh Government (2016) *Statistics and research*. Available online at: http://gov.wales/statistics-and-research/road-traffic/?lang=en

Effect	Description	Illustrative Guidance
++	Significant Positive	• Option would make a significant positive and long-term contribution to minimising the direct and indirect effects of traffic and transport associated with the GDF.
+	Positive	• Option would make a positive contribution to minimising the direct and indirect effects of traffic and transport associated with the GDF.
0	Neutral	• Option would not have any significant effects on traffic and transport.
-	Negative	• Option would have minor, short-term effects associated with the direct and indirect impacts of traffic and transport associated with the GDF.
--	Significant Negative	• Option would cause significant long-term effects associated with the direct and indirect impacts of traffic and transport associated the GDF.
?	Uncertain	• From the level of information available the effect that the option would have on this objective is uncertain.

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 11.3 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria[359]' and 'No NPS' on the traffic and transport objective. The appraisal considers in-turn the three sub-sections used for each topic within Chapter 5 (Impacts) of the draft NPS: Applicant's Assessment; Decision Making (subdivided into specific areas of interest) and Mitigation. The performance of the draft NPS and the two reasonable alternatives are scored accordingly, with a commentary provided in the Appraisal column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15-20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement. These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-

[359] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

term (less than 20 years), MT – medium-term (between 20 and 170 years) and LT – long-term (>170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

Table 11.3 Appraisal of the Draft NPS and Reasonable Alternatives: Traffic and Transport

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	**+/?**	**+/?**	**+/?**	**Draft NPS:** The text in the draft NPS under the heading of the Applicant's Assessment (Section 5.12.2) states that "*the applicant's Environmental Statement (see section 4.2) should include a transport assessment. Applicants should consult Highways England, Highway authorities the railway network operator(s), the Maritime and Coastguard Agency and the Associated British Ports, as appropriate, on the assessment and on mitigation measures. The assessment should distinguish between construction and operation stages if appropriate, although for the geological disposal facility the construction will continue through most of the operation phase. The assessment should illustrate accessibility to the site by all modes of transport and the likely split by each mode of journeys to and from the site.*" Alongside guidance on the scope of an Environmental Statement (ES), the draft NPS also sets out that applicants should prepare a travel plan including details of proposed measures to improve access so to mitigate traffic and transport impacts. The text goes on to draw attention to the possibility of co-funding by Government of any proposed transport infrastructure that would provide third party benefits. The text also highlights regulation regarding the transportation of radioactive waste and the fact that the Examining Authority need not assess the safety of radioactive materials transport. The requirement for the preparation of an ES with an associated transport assessment and consultation with Highways England, Highway Authorities and other consultees identified in the draft NPS will help to ensure that effects associated with the construction and operation of GDF-related NSIPs on traffic and transport are properly considered and appropriate mitigation measures identified. The consideration of all modes of travel and their modal split will help to inform the assessment and improve the assessment of effects. The assessment should illustrate accessibility to the site by all modes and the likely modal split of journeys to and from the site. A transport safety case must be submitted by the applicant and approved by regulators before transportation of radioactive waste must take place. This process is separate from, and not a prerequisite to any grant of development consent. As a result, the transport safety case has not been considered in this assessment. The requirement for a travel plan should help to mitigate traffic and transport impacts as the travel plan should identify opportunities for the effective promotion and delivery of sustainable transport initiatives and propose mitigation measures where necessary to avoid adverse impacts. If additional transport infrastructure is proposed, the draft NPS suggests that applicants should discuss with network providers the possibility of co-funding by Government for any third party benefits. However, this will be dependent on what, if any additional infrastructure will be required and the availability of funding and so any related benefits are uncertain at this stage. Overall, there are likely to be positive, albeit uncertain, effects on traffic and transport interests. *Recommendations for Improvement* It would be useful for the text to make direct reference to the Planning Practice Guidance (PPG) on what information should be included in transport assessments and statements (PPG Travel plans, transport assessment and statements in decision-taking, Paragraph: 015 Reference ID: 42-015-20140306). Direct reference to PPG will also serve to substantiate links to the mitigation of the residual impacts of development related to traffic and transport to ensure that the Applicant's Assessment makes the most of these opportunities (which are noted under Decision Making). Consideration should also be given to providing further guidance on the possible contents of the ES with regards to traffic and transport. The specification of the contents of the ES could be drawn from the following: • a description of the traffic-generating aspects of the development proposal leading to impacts on traffic and

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				transport; • a description of the baseline, including the principal modal routes, and for the road network, details regarding vehicle movements (using peak, 18 hours and AADT information) and the forecast changes in traffic movements (without the proposed development); • a prediction of how the transport environment will change with the proposed development: o in the shorter term, such as during the construction period; o in the longer term, during the operating life of the infrastructure, and post-closure; and o at particular times of the day, evening and night as appropriate. • an assessment of the effects of any predicted changes; and • measures to be employed in mitigating the effects of traffic (including the transport plan).
				Draft NPS including Exclusionary Criteria: The effects of this reasonable alternative would be similar to those identified in respect of the draft NPS above. However, the setting of clear criteria on siting which excludes landscape, cultural and natural heritage assets is likely to have an positive, albeit uncertain, effect as it would avoid locating development within designated areas that may already have traffic problems due to the considerable numbers of tourists and associated traffic visiting the area. It is also possible that this reasonable alternative could reduce the potential scope for the provision of new transportation infrastructure to serve NSIPs in the most effective locations. Notwithstanding, any effects are uncertain at this stage.
				No NPS: DCO applications would be subject to the provisions of national planning policy and EIA Regulations under this alternative. The absence of a clear statement on the full range of information to be submitted, with regards to traffic and transport, in the ES (as proposed in the draft NPS) risks development not effectively mitigating traffic and transport impacts. However, this reasonable alternative would still be considered to have a positive effect against the traffic and transport assessment objective.
Decision Making	**+**	**+/?**	**+/?**	**Draft NPS:** It is expected that the development of surface and subsurface facilities, as well as the movement of wastes associated with geological disposal, will require major development that will have a measurable effect on transport infrastructure. The draft NPS indicates that where proposed development may give rise to substantial impacts on the surrounding transport infrastructure, the Secretary of State, as decision maker, should ensure that the applicant has sought to mitigate these impacts. Where such impacts cannot be reduced, applicants may enter into planning obligations for funding infrastructure and mitigating adverse impacts.
				Draft NPS including Exclusionary Criteria: Setting clear exclusionary criteria for siting which specifically excludes landscape, cultural and natural heritage assets is considered unlikely to generate any additional effects beyond those identified above. However, as noted above, unintended effects could become apparent as a consequence.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				No NPS: DCO applications will be subject to the provisions of national planning policy and EIA Regulations which would be considered to have a positive, albeit uncertain, effect against the traffic and transport assessment objectives. The uncertain effects arise from the absence of a clear statement of the role of the Secretary of State in seeking to ensure that the applicant has mitigated any adverse impacts and the role that planning obligations have, for funding infrastructure or mitigating adverse effects (as proposed in the draft NPS).
Mitigation	**+**	**+**	**+/?**	**Draft NPS:** The mitigation measures contained in the draft NPS include the consideration of demand management. This is, if feasible and operationally reasonable, preferred before considering other requirements and imposing new transport infrastructure to mitigate any identified adverse impacts on transport. However, in determining applications the Secretary of State should have regard to the cost effectiveness of demand management measures compared to new transport infrastructure. The Secretary of State should also aim to secure more sustainable patterns of transport development when considering mitigation measures (Paragraph 5.12.8). The draft NPS indicates at paragraph 5.12.9 that where there are considerations between rail, water-borne or road transport, rail and water-borne options are preferred over road transport, where safe and cost-effective. It also sets out a number of scenarios where there is likely to be substantial HGV traffic and how an applicant could control the quantity of HGV movements, make sufficient provision for HGV parking and ensure satisfactory arrangements for such disruption. Additionally, the Secretary of State may attach requirements or require obligations to any development consent in order to ensure such arrangements are delivered. *Recommendations for Improvement* The mitigation measures identified in the draft NPS could be revised to be more specific and clearly reflect the potential effects associated with the key project stages of site investigation, construction, operation and closure, as summarised below[360]: *Site Investigation* Adverse effects on traffic and transport during the siting process would mainly arise as a result of the borehole drilling programme and associated activities, including in particular HGV and car movements. The number of road traffic movements generated during the site investigation is likely to be relatively small, such that significant effects on the local community or the environment would be unlikely to arise at this stage. The 2016 Geological Disposal Generic Environmental Assessment report estimates (assuming two drilling rigs) 80 cars trips per day, four buses per day and around 20 HGVs movements per week, travelling to two different locations, would be anticipated (Appendix B, Table 7). However, it is recognised that, at a very local level, there may be some intermittent disturbance from transport movements. Consideration should therefore be given to the inclusion of the following mitigation measures: • include the management and mitigation of any transportation effects in the environmental management plan for the

[360] Radioactive Waste Management Ltd (December 2016) *Geological Disposal Generic Environmental Assessment*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				drilling surveys; • seek opportunities to use more sustainable transport methods when carrying out preliminary work and minimise reliance on private cars etc.; • use locally sourced construction materials etc. where possible, including aggregates and steel casing for; • use of access/transport routes to be designed to minimise effects of transport on sensitive receptors; • suppression of dust and mud produced by HGVs though spraying water during dry and windy weather; and • regular sweeping/cleaning of access points to the public road network. *Construction, Operation & Closure* As indicated within the draft NPS, the 2016 Geological Disposal Generic Environmental Assessment report indicates that the intention, would be to maximise the use of rail as far as possible for the movement of bulk materials (i.e. delivery of construction materials, removal of excavated spoil, delivery of radioactive waste for placement and delivery of backfill materials) in order to minimise the use of HGV traffic. The balance between HGV movements and freight train movements is uncertain, and may vary from time to time according to the source of materials being delivered or the destination of materials being removed. The Generic Environmental Assessment Report indicates the following: • Car trips for staff and visitors would peak at approximately 600 per day, depending on: o Availability of shuttle buses o Availability of park-and-ride o Car occupancy rate. • If road transport was the main transport method for spoil and construction materials there could be: o A peak number of truck movements associated with excavated spoil of approximately 123 per day in higher strength rock, 77 per day in lower strength sedimentary rock and 88 per day in evaporite. o A peak number of five to ten trucks per day (10-20 movements) for surface construction materials depending on rock type. o A peak number of 5 trucks per day in higher strength rock, 18 per day in lower strength sedimentary rock and 16 for evaporite for underground construction materials During the operational phase, both construction and operational staff would access the GDF. However, the total number of vehicles associated with staff is likely to be lower than the initial construction phase (approximately 300 car journeys per day). During operation, there would be reduced levels of transport associated with bulk materials, although movements of spoil are

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				likely to continue. Deliveries of radioactive waste will commence during this period. At this stage it is assumed that the transport of radioactive waste will result in a peak of around 7 HGVs per day for low heat generating waste or less than 1 train per day if rail was used and 1 train per week for high heat generating waste. During and after decommissioning the average number of staff journeys by car during closure would be between approximately 10 and 50 per day. The number of bus journeys (direct, shuttle and park-and-ride) could be approximately 1-5 per day. There would also be export of materials from the site and potential import of materials associated with backfilling, closure and site restoration (by HGV). In addition to the continuation of the mitigation measures identified during the site investigation stage, where appropriate additional mitigation measures at the construction, operation and closure stage could include: • construction and operation-phase environmental management plan to cover transport issues, including a routing agreement for HGVs; • where practicable, provision for transport of equipment, materials and waste by rail or sea; • consideration of other alternatives to road transport (e.g. conveyors) if practicable; • consideration of potential longer term/wider use of any new transport infrastructure; and • periodic review and update of transportation related coverage in the environmental management plan(s).
				Draft NPS including Exclusionary Criteria: The specification of exclusionary criteria is unlikely to make a difference to the application of the mitigation measures and enhancement measures as set out for the draft NPS above, and as such the predicted effects are likely to be similar with regards to traffic and transport.
				No NPS: Appropriate mitigation measures will be considered by the appropriate authority in light of the proposals submitted. As such, mitigation will be forthcoming but there is the risk that they are not comprehensive or consistent (without the direction and guidance given in the draft NPS) and so will not fully address any effects arising or could be accompanied by greater uncertainty.
Other Sections of the Draft NPS Relevant to Traffic and Transport	**1. Introduction** 1.1.3 Provision is made for the consideration of effects on local transport patterns and issues in a specific locality through the requirement that a local impact report submitted by a local authority in accordance with the Planning Act. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on traffic and transport as an issue, helping to ensure that consideration is given to likely effects in a particular locality. 1.1.4 Consideration of the effects on traffic and transport is reflected in the need to apply the draft NPS in the context balancing adverse impacts and benefits. The net result of this balancing exercise could be uncertain, however. 1.1.7 The generic impacts considered in the draft NPS, along with the application of the draft NPS as a material consideration on a case by case basis, could result in			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal

uncertainty over what provisions will be applied in respect of the consideration of traffic and transport and the mitigation of adverse effects.

1.4 Consideration of deep boreholes investigations – the role and content of an ES, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of traffic and transport interests, avoiding or reducing harm and providing appropriate mitigation measures where required.

1.5 Consideration of geological disposal facilities - due to the long-term nature of the development, the applicant should take into consideration the need to retain the opportunity to maintain or upgrade infrastructure surrounding the facility over the lifetime of the project. For example, the surface facility must be resilient to the variability in climate over the operation lifetime of the facility, and be able to operate efficiently as transport systems evolve over the lifetime of the project. The spatial disposition of facilities and the timescale of development could affect traffic and transport interests although the requirements for limiting cumulative negative impacts within safety and reasonable financial constraints should help to minimise impacts. However the net long-term effects remain uncertain (although see 4.2 below).

2. Government Policy on Management of Higher Activity Radioactive Waste

2.2.6. The preference for disposal through a single site will mean that traffic and transport impacts could potentially be greater in a single location. These could be significant in respect of a particular site, dependent on the characteristics of the highway network of the host area.

2.3.7 Current plans are that high level liquid waste, which is converted in solid glass form, be stored at the surface on an interim basis for a number of decades, to allow a significant proportion of the radioactivity to reduce through a natural decay process, and for the waste to become cooler, so as to make it easier to transport and dispose of in a GDF.

2.4.3 The strategy for implementation provides for the opportunity to consider traffic and transport issues as the process proceeds iteratively in tandem with the siting process.

3. The Need for Geological Disposal Infrastructure – no direct relationship identified.

4. Assessment Principles

4.1 General principles of assessment - the scale of development proposed by a GDF could lead to significant impacts on the environment, the economy and communities. The provisions of the Planning Act and the policies and protections set out in the draft NPS provide for a balanced consideration of impacts and benefits. The requirement for the identification of positive and adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for consideration of traffic and transport issues. This section also provides detail on the principles against which the application should be judged in relation to design, environmental, health, safety and security aspects, as noted in Table 1.

4.2 Environmental Impact Assessment – the consideration of proposals within the EIA Regulations and the preparation of an ES (where required) agreed by statutory agencies and specifying mitigation measures and enhancement measures will ensure that traffic and transport interests are fully considered, as will the consideration of cumulative effects and interrelationships between effects.

4.3 Habitats Regulations Assessment – no direct relationship identified.

4.4 Alternatives – the identification of reasonable alternatives that will be required as part of scheme design and project planning should ensure that traffic and transport interests are taken into account, both in terms of protection and opportunities for mitigation and enhancement.

4.5 Criteria for 'good design for geological disposal infrastructure – no direct relationship identified.

4.6 Climate Change Adaptation – when considering a proposal, the Secretary of State should take the effects of climate change into account. Whilst the UK Government is taking measures to mitigate the effects of climate change and reducing emissions (reducing and mitigating against adverse effects and impacts against air quality), the Intergovernmental Panel on Climate Change estimate that warming will continue over the lifetime of a GDF. When preparing the ES, applications should apply, as a minimum, the emissions scenario that the Independent Committee on Climate Change suggests the world is currently most closely following – and the 10%, 50% and 90%

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	estimate ranges. The applicant should apply the CO2 high emissions scenario (high impact, low likelihood,) to those elements critical to the safe operation of the infrastructure. **4.7 Pollution Control and other Environmental Regulatory Regimes** – no direct relationship identified. **4.8 Common Law Nuisance and Statutory Nuisance** – no direct relationship identified. However, there is an indirect relationship in terms of adverse effects arising from transport which may be perceived as a nuisance. During examination, possible sources of nuisance under Section 79(1) of the Environmental Protection Act 1990 and how they may be mitigated or limited is considered by the Examining Authority. This will enable the Examining Authority to recommend appropriate requirements that the Secretary of State may wish to include in any subsequent order granting development consent Possible sources of nuisance under the 1990 Act include, inter alia: • any dust, steam, smell or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance; and • noise that is prejudicial to health or a nuisance and is emitted from or caused by a vehicle, machinery or equipment in a street. **4.9 Safety** – no direct relationship identified. **4.10 Health** – noted that where the proposed development has an effect on human beings, the ES should assess these effects for each element of the project, including traffic and transport, identifying any adverse health impacts and mitigation measures to avoid, reduce or compensate for such impacts as appropriate. **4.11 Security Considerations** – no direct relationship identified. The effects from the draft NPS and the reasonable alternatives have identified no substantive difference in effects identified against the Appraisal of Sustainability objective between reasonable alternatives. Particular generic impacts are presented separately in the draft NPS, consideration should be given to links between those generic impacts, e.g. traffic and transport with air quality, biodiversity and noise. These chapters will help to mitigate effects associated with transport.			
Summary Appraisal of Likely Significant Effects	**+**	**+/?**	**+/?**	**Draft NPS:** The transport of materials, good and personnel to and from geological disposal infrastructure is expected to have a wide range of impacts on the surrounding transport infrastructure and on other connecting networks. Impacts are expected to result from increases in noise and emissions from road transport particularly. The draft NPS seeks to identify significant transport implications through the ES and supplementary transport assessment and, aided by a transport plan, mitigate identified adverse effects appropriately. The Secretary of State must ensure that significant impacts are mitigated against, during both the construction and operation phase and that planning obligations or requirements are sought where necessary. Mitigation measures, where required, must have regard for demand management measures whilst also ensuring that cost-effectiveness is considered. The draft NPS favours the use of rail over road but sufficient scope is included to allow for road movements. Application of the draft NPS is likely to result in a positive effect in respect of minimising traffic volumes and promoting sustainable transport choices. The contents of the ES should include measures to mitigate traffic and transport impacts. It is considered that traffic movements during the siting stage would be small, relative to later stages of the project, with some limited potential for temporary negative effects, whilst during construction, operation and closure HGV movements could be up to approximately 150 HGV movements or one train per day, if the GDF were located in a high strength rock (based on the current generic assessment). The draft NPS intends to maximise the use of rail as far as possible for the movement of bulk materials in order to minimise the use of HGV traffic and any adverse effects this may have on traffic and transport. When determining, the Secretary of State can set out requirements for traffic management measures and/or new transport infrastructure so to achieve sustainable patterns of transport to mitigate any adverse effects. This, alongside other requirements set out in the draft NPS, could help to minimise direct effects with respect to traffic and transport.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Draft NPS including Exclusionary Criteria: As per the above, this reasonable alternative is the same in policy terms but includes exclusionary criteria for siting which excludes specific landscape, cultural and natural heritage assets. The overall effects of the inclusion of exclusionary criteria within the draft NPS are likely to result in a positive, albeit uncertain, effect. This reflects that the specification of exclusionary criteria within the draft NPS may result in development not being located within designated areas that may already have traffic problems due to the considerable numbers of tourist and associated traffic visiting the area. It is also possible that this reasonable alternative could reduce the potential scope for the provision of new transportation infrastructure to serve NSIPs in the most effective locations. The application of mitigation measures and enhancement measures as set out in the draft NPS will address direct and indirect effects relating to traffic and transport.
				No NPS: Despite the absence of a guiding framework for traffic and transport interests, this reasonable alternative is likely to result in positive effects overall, albeit somewhat uncertain, as any development would be subject to the provisions of national planning policy and EIA regulations. However, the absence of a clear statement on the full range of submissions requirements risks development not effectively mitigating adverse impacts. Similarly, the absence of a clear statement on the role of the Secretary of State in ensuring the applicant has mitigated any adverse effects and the role that planning obligations have also risks development not effectively mitigating adverse impacts. It is acknowledged that whilst mitigation measures would be forthcoming in this alternative, there is a risk that these are open to interpretation and that they may not fully address an appropriate range of activities. This alternative might also mean that less emphasis is placed on the role of rail and water borne options, given that the draft NPS sets out a preference for these, where they are safe and cost effective.
Summary of Recommending Mitigation and Enhancement	Although the draft NPS is considered to have a positive effect in terms of minimising the volume of traffic and promoting more sustainable transport choices, the appraisal identifies a number of recommended mitigation measures and enhancement measures that could be applied. It is suggested that the draft NPS makes direct reference to Planning Practice Guidance, with regards to traffic and transport, and makes suggestions and provides further guidance on the contents of the ES. Identified mitigation measures in the draft NPS could be revised to be more specific and clearly reflect the potential effects associated with the key project stages including processes such as full consideration of the potential environmental effects of transport and the preparation of an environmental management plan including the use of more sustainable transport methods including rail.			

12. Cultural Heritage

Introduction

This section presents the overview of plans, programmes and baseline information for the appraisal of sustainability of the National Policy Statement for Geological Disposal Infrastructure and reasonable alternatives in respect of cultural heritage.

Cultural heritage, including architectural and archaeological heritage, within this context is defined as below-ground and upstanding evidence of past human activity and encompasses artefacts, buried and underwater archaeological sites, earthworks, buildings, battlefields, historic gardens, historic landscapes, wrecks, hedgerows and ancient woodland.

There are links between the cultural heritage topic and other topics in the Appraisal of Sustainability (AoS), specifically landscape and townscape and land use, geology and soils.

Review of Plans and Programmes

The plans and programmes seek to maintain and enhance the range of historic assets in the UK. The plans and policies below provide important guidance to minimise the potential impacts of any facilities associated with a GDF particularly if it were to be cited in an area with known archaeological remains that may be disturbed by development or close to sensitive historic assets such as listed buildings and scheduled monuments.

International/European

The ***UNESCO World Heritage Convention (1972)*** aims to promote co-operation amongst nations to protect heritage that is of such outstanding value that its conservation is important for current and future generations. The Convention also established a register of World Heritage Sites. It is intended that properties on the World Heritage List will be conserved for all time. UNESCO member states commit themselves to ensure the identification, protection, conservation, and presentation of World Heritage properties.

The World Heritage Committee's ***Operational Guidelines for the Implementation of the World Heritage Convention (2013)*** set out the procedures for: the inscription of properties on the World Heritage List and the List of World Heritage in Danger; the protection and conservation of World Heritage properties; the granting of International Assistance under the World Heritage Fund; and the mobilisation of national and international support in favour of the Convention.

The ***Valletta Convention 1992,*** formally known as ***Convention for the Protection of the Archaeological Heritage of Europe*** was originally signed in London in 1969 but was revised in Valletta in 1992. It is a Europe-wide international treaty which establishes the basic common principles to be applied in national archaeological heritage policies. It supplements the general provisions of the UNESCO World Heritage Convention and aims to protect archaeological heritage as a source of the European collective memory and as an instrument for historical and scientific study. It sets out a framework which requires Member States to:

- maintain an inventory of archaeological heritage and designated protected monuments and areas;

- create archaeological reserves; and
- for finders of any element of archaeological heritage, to report and make it available to the competent authority.

It defines archaeological heritage as: "*all remains and objects and any other traces of mankind from past epochs….shall include structures, constructions, groups of buildings, developed sites, moveable objects, monuments of other kinds as well as their context, whether situated on land or under water*"'. The emphasis is on protection of sites for future study, the reporting of chance finds the control of excavations and the use of metal detectors.

UK

The ***Ancient Monuments and Archaeological Areas Act 1979*** provides for the scheduling of ancient monuments and offers the only legal protection specifically for archaeological sites in the UK. The ***Planning (Listed Buildings and Conservation Areas) Act 1990*** outlines the level of protection received by listed buildings and buildings within Conservation Areas in England and Wales.

There are a number of other Acts which afford protection to cultural and historical assets, including the ***Protection of Wrecks Act 1973***, which provides protection for shipwrecks of historical, archaeological or artistic value[361]; the ***Protection of Military Remains Act (1986),*** which provides protection for the wreckage of military aircraft and designated military vessels, and the ***Treasure Act (1996),*** which sets out procedures for dealing with finds of treasure, its ownership and rewards, in England, Wales and Northern Ireland.

The ***Enterprise and Regulatory Reform Act 2013*** made a number of changes to the specialised heritage protection system that affect heritage protection[362]:

- heritage partnership agreements may be entered into between local authorities and owners setting out works for which listed building consent is granted (excluding demolition);
- local or national Listed Building Consent Orders may be set up by a Local Planning Authority or the Secretary of State, respectively, under which works of the type described in the Order (excluding demolition) will not need listed building consent;
- a certificate of lawful proposed works is introduced (valid for 10 years) that categorically confirms that the works described in it do not affect the character of the listed building and do not therefore require consent;
- the extent of protection of a listed building can be better defined by excluding attached buildings and structures and those within the curtilage of the principal listed building from protection, and by stating definitively that some feature of a listed building is not of special architectural or historic interest;
- a certificate of immunity from listing may be applied for at any time; and
- conservation area consent has been replaced with planning permission.

[361] Note that Section 1 of the Protection of Wrecks Act 1973 was repealed in Scotland on 1 November 2013. Sites in Scottish territorial waters previously designated under this legislation have been designated as Historic Marine Protection Areas under the Marine (Scotland) Act 2010, or de-designated altogether

[362] Information from Historic England on recent changes in heritage protection. Available online at: https://www.historicengland.org.uk/advice/hpg/HP

England

The ***National Planning Policy Statement (NPPF) (Department for Communities and Local Government, 2012)*** sets out the core land use planning principles that should underpin both plan-making and decision-taking and in doing so expects planning to "conserve heritage assets in a manner appropriate to their significance, so that they can be enjoyed for their contribution to the quality of life of this and future generations".

The Framework stipulates (at paragraph 126) that local planning authorities should set out in their Local Plan a positive strategy for the conservation and enjoyment of the historic environment. In addition, it provides (at paragraph 131) that in determining planning applications, local planning authorities should take account of: the desirability of sustaining and enhancing the significance of heritage assets and putting them to viable uses consistent with their conservation; the positive contribution that conservation of heritage assets can make to sustainable communities and their economic vitality; and the desirability of new development making a positive contribution to local character and distinctiveness.

As heritage assets are irreplaceable, the Framework expects any harm or loss to require clear and convincing justification. Where a proposed development will lead to substantial harm to, or total loss of, significance of a designated heritage asset, "local planning authorities should refuse consent, unless it can be demonstrated that the substantial harm or loss is necessary to achieve substantial public benefits that outweigh that harm or loss", or all of the criteria set out in paragraph 133 (mostly relating to the lack of a viable use) apply.

The section of ***National Planning Practice Guidance (2014)*** regarding heritage provides guidance on the application of heritage policies. The Guidance also refines the definition of a logical hierarchy of heritage significance, particularly in conservation areas. It also helpfully provides clarification on the definition of the terms "optimum viable use", "substantial harm" and "public benefits", which have been the subject of wide interpretation.

Historic England, the Government's statutory adviser on the historic environment in England, and its predecessor organisations have published a number of relevant guidance documents, including the following:

- Preserving Archaeological Remains (2016);
- Conservation Area Designation, Appraisal and Management: Historic England Advice Note 1 (2016);
- Historic Environment Good Practice Advice in Planning Note 2: Managing Significance in Decision-Taking in the Historic Environment (2015);
- Historic Environment Good Practice Advice in Planning Note 3: The Setting of Heritage Assets (2015);
- The Historic Environment and Site Allocations in Local Plans. Historic England Advice Note 3 (2015); and
- Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment (2008).

Scotland

The framework for the protection and management of the Scottish historic environment is underpinned mainly by two pieces of UK legislation:

- The Ancient Monuments and Archaeological Act 1979; and,

- Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997.

The ***Historic Environment (Scotland) Act 2014*** made substantial amendments to this framework and established the new governing body of Historic Environment Scotland as a Non-Departmental Public Body to carry out the statutory functions previously delivered by Historic Scotland and the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS), which were dissolved in 2015.

Scottish Historic Environment Policy (2011) sets out Scottish Ministers' policies for the historic environment, including the following key outcomes:

- that the historic environment is cared for, protected and enhanced for the benefit of our own and future generations;
- to secure greater economic benefits from the historic environment; and
- the people of Scotland and visitors understand and enjoy the historic environment.

Following the merger of Historic Scotland and the Royal Commission on the Ancient and Historic Monuments of Scotland, the first-ever overarching strategy for Scotland's historic environment was published in March 2014. "***Our Place in Time – The Historic Environment Strategy for Scotland" (2014)*** contains a number of key aims including:

- to ensure that the cultural, social, environmental and economic value of heritage continues to make a major contribution to the nation's wellbeing;
- to investigate and record the historic environment to continually develop knowledge, understanding and interpretation of the past and how best to conserve, sustain and present it;
- to care for and protect the historic environment in order to both enjoy and benefit from it and conserve and enhance it for future benefit of future generations; and
- sharing and celebrating the richness and significance of the historic environment, enabling us to enjoy the fascinating and inspirational diversity of the heritage.

In relation to land use planning, the ***National Planning Framework 3 (2014)*** recognises the value of Scotland's historic environment and its world-renowned built heritage as a key asset[363]. Whilst the ***Scottish Planning Policy (SPP) (2014)*** reflects the value of the historic environment as a key part of Scotland's cultural heritage. The SPP (2014) sets out that with the careful application of policy and sensitive decision making, the historic environment can often be adapted to accommodate new uses, offering opportunities for new and creative design, whilst retaining its special character. In principle, therefore, the aim should be to identify the best viable use that is compatible with the fabric, setting and character of the historic environment, whilst also seeking to protect, enhance and promote access to cultural heritage.

The ***Historic Environment Scotland Policy Statement (2016)*** takes account of the Historic Environment (Scotland) Act 2014 and explains how provisions within the NPF3 92014) and SPP (2014) relating to the management of the historic environment should be interpreted. The document does not set out any planning policies or development management assessment criteria, however it does state that there should be a "presumption in favour of preservation of

[363] Scottish Government (2014) National Planning Framework 3 (2014). Available online at: http://www.gov.scot/Topics/Built-Environment/planning/National-Planning-Framework

individual historic assets and also the pattern of the wider historic environment". Historic Environment Scotland has also published a revised ***Managing Change in the Historic Environment: Setting guidance note*** (June 2016) to align with the Historic Environment Scotland Policy Statement (2016).

Planning Advice Note: (PAN) 2/2011 provides guidance to developers on the treatment of archaeological remains which is proportionate to the relative value of the remains and of the developments under consideration ***Planning Advice Note PAN 71: Conservation Area Management*** (December 2004) identifies good practice for managing change to secure the protection and enhancement of conservation areas, sets out a checklist for appraising conservation areas and provides advice on funding and implementation.

Wales

The framework for the protection and management of the Welsh historic environment is underpinned mainly by two pieces of UK legislation:

- The Ancient Monuments and Archaeological Act 1979; and
- The Planning (Listed Buildings and Conservation Areas) Act 1990.

The ***Historic Environment (Wales) Act 2016*** amends and augments this framework for the protection and sustainable management of the Welsh historic environment. In broad terms, the Act: creates new measures for the protection of listed buildings and scheduled monuments; enhances existing mechanisms for the sustainable management of the historic environment; and introduces greater transparency and accountability into decisions taken on the historic environment.

The Well-being of Future Generations (Wales) Act 2015 aims to improve the social, economic, environmental and cultural well-being of Wales. For those public bodies listed in the Act, it encourages a more joined-up approach to consider more long term, work better with people and communities and each other to prevent problems.

Planning Policy Wales (9th Edition 2016) has the following objectives regarding the historic environment:

- to preserve or enhance the historic environment, recognising its contribution to economic vitality and culture, civic pride and the quality of life, and its importance as a resource for future generations;
- to protect archaeological remains, which are a finite and non-renewable resource, part of the historical and cultural identity of Wales, and valuable both for their own sake and for their role in education, leisure and the economy, particularly tourism;
- to ensure that the character of historic buildings is safeguarded from alterations, extensions or demolition that would compromise a building's special architectural and historic interest; and
- to ensure that conservation areas are protected or enhanced, while at the same time remaining alive and prosperous, avoiding unnecessarily detailed controls over businesses and householders.

Technical Advice Note 12 (TAN 12): Design (2016) sets out the Welsh Government's policy and advice in respect of the design of new development, including sustaining or enhancing local character.

Cadw is preparing new draft policy, advice and guidance documents to supplement the legislative changes in the Historic Environment (Wales) Act 2016. These will be consistent with the ***Conservation Principles (2011)*** published by Cadw for the sustainable management of the historic environment in Wales. These will help local planning authorities, third sector groups, owners and developers to manage change in the historic environment.

Overview of the Baseline

UK

The UK has over 459,000 listed buildings, approximately 33,720 scheduled monuments, 2,416 historic parks and gardens, in excess of 10,259 conservation areas and 27 World Heritage Sites.

England

In England there are approximately 374,081 listed building entries, 19,717 scheduled monuments, 1,601 registered historic parks and gardens, 9,080 conservation areas, 43 registered historic battlefields, 46 designated wrecks and 18 World Heritage Sites (including one partially in Scotland). In 2017, the Lake District was the most recent site in England to be inscribed to the World Heritage Site list under the category of Cultural Landscape.

Historic England's ***Heritage at Risk Register (2016)***[364] identifies sites most at risk of being lost as a result of neglect, decay or inappropriate development. There are fewer entries on the 2016 Register (5,341) when compared to the 2015 Register (5,478). Historic England report the following findings:

- 926 (6.3%) of listed places of worship are on the Register;
- 2,582 (13.0%) of England's 19,848 scheduled monuments are on the Register;
- Arable cultivation (39%) and unrestricted plant, scrub and tree growth (26%) remain the most common sources of risk;
- 95 (5.8%) of England's 1,639 registered parks and gardens are on the Register;
- Of the 46 registered battlefields in England, 6 (13.0%) are on the Register. 6 (12.2%) of the 49 protected wreck sites around England's coast are on the Register 4 lie off the South East coast, 1 off the South West and 1 off the East of England.

Scotland

In Scotland there are approximately 8,238 scheduled monuments[365] in excess of 47,000 listed buildings[366], in excess of 600 conservation areas, six World Heritage Sites (including one partially in England), and more than 275 sites listed in the Inventory of Historic Parks, Gardens

[364] Historic England (2016) *Heritage at Risk Register 2016*. Available online at: https://historicengland.org.uk/whats-new/news/heritage-at-risk-2016

[365] Historic Environment Scotland (2017) *Designations.* Avaiable online at: http://data.historic-scotland.gov.uk/pls/htmldb/f?p=2300:30:0

[366] Scottish Government (2010) *Land Use Strategy, Strategic Environmental Assessment Screening and Scoping Report.* Available online at: http://www.gov.scot/Resource/Doc/1051/0095735.pdf

and Designed Landscapes. There are also eight Historic Marine Protected Areas[367] and over 35 Inventory Battlefields[368].

Wales

In Wales there are over 4,000 scheduled monuments, 30,000 listed buildings, 500 conservation areas, 3 World Heritage Sites, almost 400 historic parks and gardens, and 6 designated historic wrecks[369].

Since 2011, the percentage of buildings 'at risk' or in vulnerable condition has decreased from 9.22% to 8.92%[370]. The Historic Landscapes Register for Wales has identified 58 landscapes across Wales which are regarded as representing the best examples of the variety of historic landscapes in Wales.

Summary of Existing Problems Relevant to the Geological Disposal NPS

The following existing problems for cultural heritage have been identified:

- The settings of heritage assets are at risk from new development.
- Scheduled monuments in rural areas are at risk from intensive grazing practices and unrestricted plant, scrub or tree growth.
- Challenging economic conditions are reducing the funds available to conserve and manage heritage assets.

Likely Evolution of the Baseline

Key findings from the latest Buildings at Risk and Heritage at Risk registers are reported above. Whilst these do not provide projections regarding the future state of the historic environment they do indicate the level of known heritage assets which require ongoing conservation, protection and care.

Assessing Significance

The objectives and guide questions related to cultural heritage which have been identified for use in the appraisal of the effects of Geological Disposal Infrastructure NPS proposals are set out in **Table 12.1**, together with reasons for their selection.

[367] Scottish Government (2017) *Historic Marine Protected Area Records*. Available online at: https://www.historicenvironment.scot/advice-and-support/listing-scheduling-and-designations/marine-heritage/historic-marine-protected-area-records/
[368] Historic Environment Scotland (2106) *Scotland's Inventory of Historic Battlefields 2016.* Available online at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=c59262de-b652-4e68-b88d-a5fe008ff1c8
[369] Cadw (2016) *Protection.* Available online at: http://cadw.gov.wales/historicenvironment/protection/?lang=en
[370] Cadw (2016) *Buildings at Risk*. Available online at: http://cadw.gov.wales/historicenvironment/protection/buildconservation/buildingsatrisk/?lang=en

Table 12.1 Approach to Assessing the Effects of the Geological Disposal Infrastructure NPS on Cultural Heritage

Objective/Guide Question	Reasoning
Objective: To protect and where appropriate enhance the historic environment including cultural heritage resources, historic buildings and archaeological features and their settings.	The SEA Directive (2001/42/EC) requires that the likely significant effects on cultural heritage including architectural and archaeological heritage should be taken into account in the Environmental Report, which for the purposes of the AoS is incorporated within the AoS Report.
Will the Geological Disposal Infrastructure NPS affect designated or locally-important archaeological features or their settings?	A number of legislative provisions require the protection of sites designated for archaeological or cultural heritage importance including the Ancient Monuments and Archaeological Areas Act 1979 and Planning (Listed Buildings and Conservation Areas) Act 1990. National planning policy in England requires the protection of the most important components of historic landscapes and encourages development that is consistent with maintaining its overall historic character.
Will the Geological Disposal Infrastructure NPS affect the fabric and setting of historic buildings, places or spaces that contribute to local distinctiveness, character and appearances?	

Table 12.2 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the cultural heritage objective.

Table 12.2 Illustrative Guidance for the Assessment of Significance for Cultural Heritage

Effect	Description	Illustrative Guidance
++	Significant Positive	• Option would make a significant positive and long-term contribution to the setting and conservation of designated and locally important cultural heritage features (e.g. through enhancement of setting, permanent removal of a structure creating a negative visual impact, large scale enhancement of designated features).
+	Positive	• Option would bring minor short-term improvements to the setting and conservation of designated and locally important cultural heritage features (e.g. temporary removal of structure creating a negative visual impact).
0	Neutral	• Option would not have any significant effects on any cultural heritage sites or assets or their setting.
-	Negative	• Option would result in short-term degradation to the setting and conservation of designated and locally important cultural heritage features (e.g. temporary use of equipment/structures creating a negative visual impact).
--	Significant Negative	• Option would cause long-term degradation to the setting and conservation of designated and locally important cultural heritage features (e.g. through direct and permanent loss or damage to historic assets or the introduction of a structure that will have a considerable and permanent negative visual impact).

Effect	Description	Illustrative Guidance
?	Uncertain	• From the level of information available the effect that the option would have on this objective is uncertain.

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 12.3 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria[371]' and 'No NPS' on the cultural heritage objective. The appraisal considers in-turn the three sub-sections used for each topic within Chapter 5 (Impacts) of the draft NPS: Applicant's Assessment; Decision Making and Mitigation. The performance of the draft NPS and the two reasonable alternatives are scored accordingly, with a commentary provided in the Appraisal column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15 - 20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement. These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-term (less than 20 years), MT – medium-term (between 20 and 170 years) and LT – long-term (>170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

[371] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

Table 12.3 Appraisal of the Draft NPS and Reasonable Alternatives: Cultural Heritage

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	**+**	**++/?**	**+/?**	**Draft NPS:** In the introduction to the historic environment section, the draft NPS defines heritage assets as: "*5.6.3 Those elements of the historic environment that hold value to this and future generations because of their historic, archaeological, architectural or artistic interest are called 'heritage assets'. Heritage assets may be buildings, monuments, sites, places, areas or landscapes*." Under the Applicants Assessment section, the draft NPS states: "*5.6.7 The applicant should undertake an assessment of any likely significant heritage impacts of the proposed development as part of the Environmental Impact Assessment and describe these in the Environmental Statement. This should include consideration of heritage assets above, at and below the surface.* *5.6.8 The applicant should describe the significance of any heritage assets affected, including any contribution made by their setting*. *5.6.9 The applicant is encouraged, where opportunities exist, to prepare proposals which can make a positive contribution to the historic environment, and to consider how their scheme takes account of the significance of heritage assets affected*" The requirement for the preparation of an Environmental Statement (ES) will ensure that the likely effects on cultural heritage are properly considered (subject to more detailed specification of the contents of the ES in respect of cultural heritage). Consideration of surface and underground facilities will help to ensure that the full range of impacts is taken into account and opportunities for enhancement considered. Overall, there are likely to be positive effects on cultural heritage interests. The current text does not provide guidance on the contents of an Environmental Statement with regard to cultural heritage. *Recommendations for Improvement* It would be useful for the text to make direct reference to the Planning Practice Guidance on how cultural heritage matters should be dealt with as part of a development consent application (PPG Conserving and enhancing the Historic Environment). Direct reference should also be made to the guidance issued by Historic England[372]. Consideration should be given to providing further guidance on the possible contents of the ES with regards to cultural heritage. Specification of the contents of the ES could be set out which also serves as the reference point for the detail of the

[372] Historic England (2015)
- The Historic Environment in Local Plans - Historic Environment Good Practice Advice in Planning: 1
- Managing Significance in Decision-Taking in the Historic Environment Historic Environment Good Practice Advice in Planning: 2
- The Setting of Heritage Assets Historic Environment Good Practice Advice in Planning: 3

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Decision Making section: • Planning policy context • Methodology • Baseline environment • Key parameters for assessment • Assessment criteria and assignment of significance • Assessment of significance
				Draft NPS including Exclusionary Criteria: Positive effects on cultural heritage associated with this reasonable alternative are expected to be similar to those identified in respect of the draft NPS, although the magnitude of effect would be greater. This reflects the expectation that the exclusion of siting of geological disposal infrastructure affecting designated cultural heritage assets such as World Heritage Sites would help to avoid/lessen adverse impacts on the significance of these assets, providing greater certainty with respect to the location of development. However, simply excluding works from within a cultural heritage asset such as a World Heritage Site would not necessarily exclude the possibility of adverse effects on the significance of such assets (although the general risk of adverse effects is assumed to be reduced). In particular, adverse effects on the setting of a World Heritage Site could still arise if geological disposal facilities were sited adjacent or close to the boundary of a site, although it would be expected that the significance of any such effects could be reduced through the implementation of appropriate mitigation such as good design and consideration of layout. Additionally, there is the potential for unintended effects to be produced as a consequence of greater development pressure on areas/sites not afforded such high levels of protection. Whilst this is currently uncertain, given existing policy and legislation on cultural heritage and the requirements of the draft NPS, such unintended effects are considered to be unlikely to occur. It is important to note that existing national planning policy and legislation, together with the requirements of the draft NPS (as proposed), provide for the protection of cultural heritage assets such as World Heritage Sites such that it can be reasonably expected that the potential for adverse impacts in this regard would be fully considered at the project stage. Even where there is the potential for adverse impacts to arise as a result of the development of geological disposal infrastructure, in many cases it is likely that these impacts could be avoided, minimised or mitigated through, for example, design measures (and in accordance with the provisions of the draft NPS).
				No NPS: Whilst applications would be subject to the provisions of national planning policy and EIA Regulations under this alternative and which would therefore still be considered to have a positive effect against the cultural heritage assessment objective, the absence of a clear statement of the full range of considerations to be taken into account (as proposed in the draft NPS) risks inconsistency in interpretation, particularly at a project level.
Decision Making	**+**	**++/?**	**+/?**	**Draft NPS:** The draft NPS sets out in detail the range of considerations which will be part of the decision making process, including the importance of understanding the nature of the cultural heritage assets which could be affected (including their setting) and opportunities for their enhancement where appropriate. The guidance reflects policy set out in the NPPF with regard to conserving and enhancing the historic environment (section 12, paras 126 – 141). As such, the likely effects are

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				positive and impacts will be sought to be minimised, although broader strategic development considerations, such as the need for the facility, could override cultural heritage interests where impacts cannot be avoided.
				Draft NPS including Exclusionary Criteria: In addition to providing the guidance in the draft NPS, setting clear exclusions for siting which specifically excludes landscape, cultural and natural heritage assets from the outset would help to establish clearer parameters for decision making and would have significant positive effects on cultural heritage. However, as noted above, simply excluding works from within a cultural heritage asset such as a World Heritage Site would not necessarily exclude the possibility of adverse effects on the significance of such assets (although the general risk of adverse effects is assumed to be reduced). In particular, adverse effects on the setting of a World Heritage Site could still arise if geological disposal facilities were sited adjacent or close to the boundary of a site, although it would be expected that the significance of any such effects could be reduced through the implementation of appropriate mitigation such as good design and consideration of layout. Additionally, there is the potential for unintended effects to be produced as a consequence of greater development pressure on areas/sites not afforded such high levels of protection. Whilst this is currently uncertain, given existing policy and legislation on cultural heritage and the requirements of the draft NPS, such unintended effects are considered to be unlikely to occur. It is important to note that existing national planning policy and legislation, together with the requirements of the draft NPS (as proposed), provide for the protection of cultural heritage assets such as World Heritage Sites such that it can be reasonably expected that the potential for adverse impacts in this regard would be fully considered at the project stage. Even where there is the potential for adverse impacts to arise as a result of the development of geological disposal infrastructure, in many cases it is likely that these impacts could be avoided, minimised or mitigated through, for example, design measures (and in accordance with the provisions of the draft NPS).
				No NPS: Whilst applications will be subject to the provisions of national planning policy and EIA Regulations which would still be considered to have a positive effect against the cultural heritage assessment objective, the absence of a clear statement of the full range of considerations to be taken into account (as proposed in the draft NPS) risks inconsistency in interpretation, particularly at a project level.
Mitigation	**+/?**	**+/?**	**+/?**	**Draft NPS:** The proposed mitigation sets out the minimum expectations associated with development and those which are commonly attached as conditions to a large development consent application. Positive effects are likely but as drafted they miss a significant opportunity to properly reflect the aspirations set out in the Assessment and Decision Making sections for cultural heritage which could more fully address the disturbance and setting of assets.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Recommendations for Improvement The mitigation could be revised to be more specific and clearly reflect the key project stages of site investigation, construction, operation and closure, as follows[373]: *Site Investigation* Construction of borehole drilling pads, access roads and support infrastructure, could result in the direct loss or damage to: • visible above ground cultural historic or archaeological features and historic landscapes; • buried archaeological remains; and • historic buildings and monuments. The potential for archaeology below a depth of 1-3m is considered to be limited, except in defined areas (such as mining areas). Therefore the greatest effects would be seen during construction works, shallow surface investigations such as trial pitting and trenching, and shallow borehole drilling. Although they would be caused by temporary works, any such effects would be permanent in nature. In addition such works could cause temporary effects on the setting of historic buildings, ancient monuments, archaeological features visible above ground and historic landscapes. Consideration should therefore be given to specifying mitigation which could involve: • Avoid designated heritage assets or undesignated assets of equivalent value. • Avoid other heritage assets where possible or take steps to minimise adverse effects. • Site the works sensitively with regard to the setting of heritage assets. • Design methodology for compounds, access roads etc. to minimise ground disturbance • Conduct archaeological watching brief Liaise with appropriate archaeological curator/ other authorities re other mitigation needs. *Construction* As for the assumption for site investigation, the majority of any archaeological features, historic buildings and landscapes and other cultural heritage features are likely to be visible above ground or within 1-3 metres below it. Any such features could be affected by:

[373] Derived from: Radioactive Waste Management Ltd. (October 2016) *Geological Disposal Generic Environmental Assessment*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• surface construction activities resulting in direct loss of or damage; • construction activities negatively affecting the setting and amenity of features and landscapes; • contamination, ground consolidation, or hydrological changes; and • if dewatering is required during construction and this affects surface deposits, this could significantly affect any peatlands or other palaeoenvironmental remains if present. Mitigation associated with this phase could therefore involve, in addition to the continuation of the above: • Avoid Scheduled Monuments, Listed Buildings or other designated heritage assets or undesignated assets of equivalent value; • Select site and design GDF with consideration of potential effects on the setting of historic buildings and other heritage assets; • Seek to maintain the integrity of historic landscapes where practicable; • Consider the setting of heritage assets, integrity of historic landscapes etc. in design of landscaping works; • Seek opportunities to maintain and enhance access to heritage assets where appropriate; and • Liaison with local community regarding cultural environments. *Operation & Closure* No new direct physical effects on cultural heritage remains within a GDF site would occur during the operation phase. Any effects on the setting of historic buildings or monuments in the vicinity of a GDF would continue throughout the operation phase, although their significance may be reduced as mitigation works mature. Mitigation could therefore involve, in addition to the continuation of the above: • Seek opportunities to enhance access to heritage assets as a recreational or educational resource where appropriate • Ongoing maintenance of any mitigation works relating to the setting of nearby heritage assets Surface activities associated with backfilling, sealing and closure, and decommissioning of the surface facilities and infrastructure could affect the setting and amenity of any historic buildings or other historic/ archaeological monuments and landscapes in the vicinity of a GDF. Effects would be of a similar, or lesser, scale and nature as above and any visual screening and enhancements would be well established. No further significant effects are anticipated. Again, site specific assessment would be necessary to determine specific effects on cultural heritage. For site closure, in addition to the continuation of the above: • Establish ‘legacy’ maintenance arrangements for heritage assets on site or in vicinity and for any access

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				arrangements • Ensure closure does not compromise setting of any nearby heritage assets
				Draft NPS including Exclusionary Criteria: The specification of exclusionary criteria is unlikely to make a difference to the application of the mitigation and enhancement measures as set out for the NPS above, and as such the predicted effects are likely to be similar.
				No NPS: Appropriate mitigation measures will be considered by the competent authority in light of the proposals submitted. As such, mitigation measures will be applied but there is the risk that this is open to interpretation and thereby does not fully address an appropriate range of activities which are directly related to the scheme rather than generic in character which serve the interests of cultural heritage.
Other Sections of the Draft NPS Relevant to Cultural Heritage	**1. Introduction** 1.1.3 There is an opportunity for the consideration of effects on cultural heritage in a specific locality through the preparation of a local impact report submitted by a local authority in accordance with the Planning Act. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on cultural heritage as an issue, helping to ensure that consideration is given to likely effects in a particular locality. 1.1.4 Protection of cultural heritage interests is reflected in the need to apply the draft NPS in the context of international obligations and to balance adverse impacts and benefits. The net result of this balancing exercise could be uncertain, however. 1.1.7 The generic impacts considered in the draft NPS, along with the application of the NPS as a material consideration on a case by case basis, could result in uncertainty over what provisions will be applied in respect of the protection of cultural heritage interests and the mitigation of adverse effects. **1.4 Consideration of deep boreholes investigations** – the role and content of an Environmental Statement, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of cultural heritage interests, avoiding or reducing harm and providing appropriate mitigation where required. **1.5 Consideration of geological disposal facilities** – the spatial disposition of facilities and the timescale of development could affect cultural heritage interests although the requirements for limiting cumulative negative impacts within safety and reasonable financial constraints should help to minimise impacts. **2. Government Policy on Management of Higher Activity Radioactive Waste** 2.2.6. The preference for disposal through a single site will help to confine effects to a specific area thus limiting effects on cultural heritage, although these could still be significant in respect of that particular site and environs, depending on the assets present. 2.4.3 The strategy for implementation provides for the opportunity to consider cultural heritage interests as the process proceeds iteratively, including discussions with communities of interest. **3. The Need for Geological Disposal Infrastructure** The identification of technical and ethical considerations which prompt the need to provide for a GDF will benefit cultural heritage interests through the adoption of a responsible approach to waste disposal, based on various factors which include the discussions with interested communities.				

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
	1. Assessment Principles **4.1 General principles of assessment** - the provisions of the Planning Act and the policies and protections set out in the NPS provide for a balanced consideration of needs. The requirement for the identification of adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for the protection and enhancement of cultural heritage interests. **4.2 Environmental Impact Assessment** – the consideration of proposals within the EIA Regulations and the preparation of an Environmental Statement (where required) agreed by statutory agencies and specifying mitigation and enhancement measures will ensure that cultural heritage interests are fully considered, as will the consideration of cumulative effects and interrelationships between effects **4.3 Habitats Regulations Assessment** – no direct relationship identified. **4.4 Alternatives** – the identification that reasonable alternatives will be required as part of scheme design and project planning should ensure that cultural heritage interests are taken into account, both in terms of protection and opportunities for mitigation and enhancement. **4.5 Criteria for good design for geological disposal infrastructure** - attention to good design principles and implementation will be of benefit to cultural heritage interests through the consideration of how a proposed facility interacts with its context. **4.6 Climate Change Adaptation** – no direct relationship identified. **4.7 Pollution Control and other Environmental Regulatory Regimes** – no direct relationship identified. **4.8 Common Law Nuisance and Statutory Nuisance** – no direct relationship identified. **4.9 Safety** – no direct relationship identified. **4.10 Health** – no direct relationship identified. **4.11 Security Considerations** – no direct relationship identified. The effects from the draft NPS and the reasonable alternatives to it are considered to be more positive than the reasonable alternatives, reflecting the specification of expectations associated with, in particular, design criteria. As part of the design process and mitigation strategy there are important links to be made with the biodiversity and landscape topics, reflecting shared space and common features such as woodland or listed buildings.			
Summary Appraisal of Likely Significant Effects	**+**	**++**	**+/?**	**Draft NPS:** Application of the draft NPS is likely to result in positive effects in respect of the protection and enhancement of cultural heritage interests, reflecting the specification of the parameters associated with site investigation, construction and operation of a GDF. The draft NPS framework will be applied in light of existing legislation at international and national levels in principle protecting cultural heritage interests, although this will be a balancing exercise reflecting national need and other considerations. Where cultural heritage interests are affected the draft NPS provides for the application of clear mitigation measures, addressing direct and indirect effects, which should result in positive effects. **Draft NPS including Exclusionary Criteria:** The overall effects of the inclusion of exclusionary criteria within the draft NPS are likely to be similar to those relating to the draft NPS, although the magnitude will be greater. This reflects the expectation that the exclusion of siting of geological disposal infrastructure affecting designated cultural heritage assets such as World Heritage Sites would help to avoid adverse impacts on the significance of these assets, providing greater certainty with respect to the location of development.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				However, simply excluding works from within a cultural heritage asset such as a World Heritage Site would not necessarily exclude the possibility of adverse effects on the significance of such assets (although the general risk of adverse effects is assumed to be reduced). In particular, adverse effects on the setting of a World Heritage Site could still arise if geological disposal facilities were sited adjacent or close to the boundary of a site, although it would be expected that the significance of any such effects could be reduced through the implementation of appropriate mitigation such as good design and consideration of layout. Additionally, there is the potential for unintended effects to be produced as a consequence of greater development pressure on areas/sites not afforded such high levels of protection. Whilst this is currently uncertain, given existing policy and legislation on cultural heritage and the requirements of the draft NPS, such unintended effects are considered to be unlikely to occur. It is important to note that existing national planning policy and legislation, together with the requirements of the draft NPS (as proposed), provide for the protection of cultural heritage assets such as World Heritage Sites such that it can be reasonably expected that the potential for adverse impacts in this regard would be fully considered at the project stage. Even where there is the potential for adverse impacts to arise as a result of the development of geological disposal infrastructure, in many cases it is likely that these impacts could be avoided, minimised or mitigated through, for example, design measures (and in accordance with the provisions of the draft NPS).
				No NPS: In the absence of a draft NPS, the provisions of national planning policy and EIA Regulations would still be considered to have a positive effect against the cultural heritage assessment objective. However, the absence of a guiding framework for cultural heritage interests is likely to result in increased uncertainty, reflecting the absence of clear expectations as to siting and design relating the specific case of a GDF as well as uncertainty and inconsistency in their application. The precise range of mitigation applied as part of any scheme development would potentially be less certain and with greater inconsistency than under a NPS.
Summary of Recommended Mitigation and Enhancement	The mitigation measures proposed by the draft NPS reflect those expected to be set out as part of the conditions attached to any application. They could more fully reflect the specification set out in the Applicant's Assessment and Decision Making Criteria and relate more specifically to project stages (site investigation, construction, operation & closure) and thereby the likely specific impacts associated with a development of this nature. These would establish a clear specification for use by applicant and appraisal by the competent authority. Equally, there could be more attention paid to specific design principles associated with the project lifecycle and by implication the mitigation measures which can reasonably be applied.			

13. Landscape and Townscape

Introduction

This section presents the overview of plans, programmes and baseline information for the appraisal of sustainability of the National Policy Statement for Geological Disposal Infrastructure and reasonable alternatives in respect of landscape and townscape.

Landscape in this context is defined by The **European Landscape Convention** as "*an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors*". This definition is stated as covering natural, rural, urban and peri-urban (i.e. the urban-rural fringe) and includes land, inland water and marine areas. For the purposes of this appraisal though, landscape is taken to apply to rural areas and townscapes in urban areas. Visual effects are those effects that influence how people see a landscape or townscape, such as the erection of a building.

There are links between the landscape and townscape topic and other topics in the Appraisal of Sustainability (AoS), including in particular biodiversity and nature conservation and cultural heritage.

Review of Plans and Programmes

The plans and programmes reviewed seek to protect and enhance the broad variety of landscapes and townscapes. The plans and policies below provide important guidance to minimise the potential impacts of any surface facilities associated with a GDF particularly if it were to be cited in a sensitive landscape such as an AONB or National Park, which is the case for a number of the UKs existing nuclear facilities.

International

The ***European Landscape Convention 2004*** is principally directed at the national level, but emphasises the importance of landscape as a cultural as well as an aesthetic asset. The Convention also calls for improved public involvement in landscape matters. The UK became a signatory to the European Landscape Convention in 2006.

UK

In the UK, there are numerous Acts governing the protection of the countryside, landscape and natural environment. The ***National Parks and Access to the Countryside Act 1949*** makes provision for National Parks, confers powers for the establishment and maintenance of nature reserves, makes provision for the recording, creation, maintenance and improvement of public paths and for securing access to open country and confers further powers for preserving and enhancing natural beauty.

National Parks are areas of relatively undeveloped and scenic landscape. Designation as a National Park may include substantial settlements and human land uses which are often integral parts of the landscape. Land within a National Park remains largely in private ownership. Each National Park is operated by its own National Park authority, with two 'statutory purposes':

- to conserve and enhance the natural beauty, wildlife and cultural heritage of the area; and
- to promote opportunities for the understanding and enjoyment of the Parks.

Areas of Outstanding Natural Beauty (AONBs) are areas of high scenic quality that have statutory protection in order to conserve and enhance the natural beauty of their landscapes. AONB landscapes range from rugged coastline to water meadows to gentle lowland and upland moors. Natural England has a statutory power to designate land as AONB.

The ***Countryside and Rights of Way Act 2000*** increased the duty of provision of public access to the countryside and strengthened legislation relating to Sites of Special Scientific Interest (SSSIs). In particular, it requires public bodies to further the conservation and enhancement of SSSIs both in carrying out their operations, and in exercising their decision making functions.

The ***Marine and Coastal Access Act 2009*** seeks to ensure clean, healthy, safe, productive and biologically diverse oceans and seas, by putting in place better systems for delivering sustainable development of marine and coastal environment.

Other relevant Acts include:

- The Forestry Act 1967 restricts and regulates the felling of trees. The Countryside Act 1968 enlarges the function of the Agency established under the National Parks and Access to the Countryside Act 1949, to confer new powers on local authorities and other bodies for the conservation and enhancement of natural beauty and for the benefit of those resorting to the countryside;
- The Agriculture Act 1986 (with numerous revisions) covers the provision of agricultural services and goods, agricultural marketing compensation to tenants for milk quotas, conservation and farm grants; and
- The Commons Act 2006, which protects common land and promotes sustainable farming, public access to the countryside and the interests of wildlife.

England

The ***Natural Environment and Rural Communities Act 2006*** ('the NERC Act') is designed to help achieve a rich and diverse natural environment and thriving rural communities through modernised and simplified arrangements for delivering Government policy. The NERC Act established a new independent body - Natural England - responsible for conserving, enhancing, and managing England's natural environment for the benefit of current and future generations. The Act made amendments to both the Wildlife and Countryside Act 1981 and the Countryside and Rights of Way Act 2000, which further enhance provisions to biodiversity generally and SSSIs in particular.

The ***National Planning Policy Framework (NPPF)*** **(Department for Communities and Local Government, 2012)** includes strong protections for valued landscapes and townscapes as well as recognising the intrinsic character and beauty of the countryside. The importance of planning positively for high quality design is underlined and local and neighbourhood plans are expected to "*develop robust and comprehensive policies that set out the quality of development that will be expected for the area*". Planning policies and decisions are expected to respond to local character and history, and reflect the identity of local surroundings and materials, while not preventing or discouraging appropriate innovation. The Framework states (at paragraph 64) that: "*Permission should be refused for development of poor design that fails*

to take the opportunities available for improving the character and quality of an area and the way it functions".

The Framework has a number of specific requirements relating to planning and landscape including a clear expectation that the planning system should contribute to, and enhance, the natural and local environment by protecting and enhancing valued landscapes. Local planning authorities are expected to set criteria based policies against which proposals for any development on or affecting protected landscape areas will be judged. In doing so, distinctions should be made between the hierarchy of international, national and locally designated sites and "*great weight*" should be given to "*conserving landscape and scenic beauty in National Parks, the Broads and Areas of Outstanding Natural Beauty*". Local planning authorities in their plan-making are also expected to take account of changes to landscape and develop a clear strategy for enhancing the natural, built and historic environment. Where appropriate, "*landscape character assessments should also be prepared, integrated with assessment of historic landscape character, and for areas where there are major expansion options, assessments of landscape sensitivity*".

One of the core principles in the NPPF is that planning should recognise the intrinsic character and beauty of the countryside. Local plans should include strategic policies for the conservation and enhancement of the natural environment, including landscape. This includes designated landscapes but also the wider countryside. Where appropriate, landscape character assessments should be prepared to complement Natural England's National Character Area profiles. Landscape Character Assessment is a tool to help understand the character and local distinctiveness of the landscape and identify the features that give it a sense of place. It can help inform, plan and manage change and may be undertaken at a scale appropriate to local and neighbourhood plan-making.

National Planning Practice Guidance provides guidance on the application of landscape policies. It sets out that planning policies and decisions should be based on up-to-date information about the natural environment and other characteristics of the area including management plans for National Parks and Areas of Outstanding Natural Beauty (AONBs).

The ***Natural Environment White Paper (NEWP) The Natural Choice: securing the value of nature (2011)*** recognises that a healthy natural environment is the foundation of sustained economic growth, prospering communities and wellbeing. It sets out how the value of nature can be mainstreamed across society by facilitating action; strengthening the connections between people and nature; creating a green economy and showing leadership in the EU and internationally. It sets out 92 specific commitments for an action and since its publication in 2011, Defra has published periodic NEWP implementation updates highlighting significant progress.

Scotland

The ***Countryside (Scotland) Act 1967*** makes provision for the better enjoyment of the Scottish countryside, the establishment of a Countryside Commission for Scotland and for the improvement of recreational and other facilities. The ***National Parks (Scotland) Act 2000*** provides the legislative framework for National Park designations in Scotland. The Land Reform (Scotland) Act 2003 establishes a right to be on land for recreational, educational and certain other purposes and a right to cross land. The Act also places a duty on each a local authority to prepare a Core Paths Plan and provides that access rights are exercisable in respect of all Core Paths.

The ***Scottish Planning Policy (SSP) 2014*** sets out several broad principles with regard to landscape, including taking a broader approach to landscape and natural heritage, considering

the natural and cultural components of the landscape together, promoting opportunities for enhancement or restoration of degraded landscapes, safeguarding the character of the most sensitive landscapes, and considering potential effects on the landscape, including the cumulative effect of incremental changes, when deciding planning applications. SPP requires local authorities to apply the precautionary principle where the impacts of a proposed development on nationally or internationally significant landscape or natural heritage resources are uncertain but there is sound evidence for believing that significant irreversible damage could occur.

Scotland's ***Third National Planning Framework (NPF3)***, the spatial expression of the Government Economic Strategy, sets out a long-term vision for development and investment across Scotland over the next 20 to 30 years. NPF3 focuses on supporting sustainable economic growth and the transition to a low carbon economy. NPF3 sets out the ambition for Scotland as a whole, and highlights the distinctive opportunities for sustainable growth in the cities and towns, the rural areas and coast and islands. NPF3 will be taken into account in all strategic and local development plans in Scotland. Fourteen national developments across Scotland are identified to deliver the strategy.

Planning Advice Note 60 (PAN60): Planning for Natural Heritage provides guidance on how development and the planning system can contribute to the conservation, enhancement, enjoyment and understanding of Scotland's natural environment and encourages developers and planning authorities to be positive and creative in addressing natural heritage issues.

Wales

The ***Well-being of Future Generations (Wales) Act 2015*** became law in Wales on 29th April 2015 and strengthens existing governance arrangements for improving the well-being of Wales to ensure that present needs are met without compromising the ability of future generations to meet their own needs. The act identifies goals to improve the well-being of Wales, introduces national indicators that will measure the difference being made to the well-being of Wales, establishes a Future Generations Commissioner for Wales to act as an advocate for future generations and puts local service boards and well-being plans on a statutory basis and simplifies requirements for integrated community planning.

The ***Environment (Wales) Act 2016*** establishes the principles that determine how the sustainable management of natural resources is to be delivered. The principles, which are complementary and interlinked, include requires that the benefits provided by natural resources and ecosystems be identified and considered , as well as the intrinsic value of those ecosystems and resources, which is the value of natural resources and ecosystems for their own sake. All provisioning, supporting, regulating and cultural benefits (or services) should be considered, as appropriate, in the sustainable management of natural resources.

The ***Planning (Wales) Act 2015*** requires public bodies to exercise their functions relating to development plans and applications for planning permission as part of carrying out sustainable development, so that the development and use of land contribute to improving the well-being of Wales.

Planning Policy Wales (Edition 9) (2016) sets out several objectives regarding landscape, including promoting the conservation of landscape and biodiversity, ensuring that Wales contributes to meeting international responsibilities and obligations and ensuring that statutorily designated sites are properly protected and managed. It also notes that it is important that landscape considerations are taken into account at an early stage in both development plan preparation and development management.

Technical Advice Note (TAN) 6: Planning for Sustainable Rural Communities (2010) provides practical guidance on the role of the planning system in supporting the delivery of sustainable rural communities. The TAN seeks to protect and enhance Wales' landscapes.

Technical Advice Note 12 (TAN 12): Design (2016) sets out the Welsh Government's policy and advice in respect of the design of new development, including sustaining or enhancing local character.

Overview of the Baseline

UK

Statutory sites designated (wholly or partially) for their landscape value include National Parks, Areas Outstanding Natural Beauty (AONBs) (in England and Wales), Country Parks, Registered Historic Parks and Gardens, Historic Gardens and Designed Landscapes, National Scenic Areas (NSAs) and Regional Parks (in Scotland) and World Heritage Sites. Other important (non-statutory) sites include Areas of Great Landscape Value (AGLV) in Scotland; Heritage Coasts (in England and Wales); and National Trust/National Trust for Scotland properties.

The UK has 15 National Parks and (excluding Scotland) 46 AONBs. Each National Park is administered by its own National Park Authority whose duty it is to conserve and enhance natural beauty, wildlife and cultural heritage; and to promote opportunities for the understanding and enjoyment of the special qualities of National Parks by the public. The Broads Authority in England has a third purpose to protect the interests of navigation. The primary purpose of AONB is to conserve and enhance the natural beauty of the landscape.

Many of the UK's nuclear facilities are situated in relatively rural locations. The general scale of the buildings associated with existing nuclear facilities has a relatively significant effect on the landscape and are, as such, relatively noticeable features. A number of existing nuclear facilities are also located within, or in close proximity, to designated landscape areas, such as National Parks, AONB and Heritage Coasts[374].

England

There are ten National Parks in England; the most recently designated National Park being the South Downs National Park (designated on 31 March 2010). Together, National Parks cover 9.3% of the land area in England and include 453 conservation areas[375].

There are 34 AONBs in England, one of which straddles England and Wales (the Wye Valley AONB). AONBs cover 18% of England and Wales[376]. The East Hampshire and Sussex Downs AONB designations were revoked on the 31 March 2010 when the South Downs National Park Designation Order came into effect.

England has been divided into areas with similar landscape character, which are called National Character Areas (NCAs). A total of 159 NCAs have been identified in England[377].

[374] Radioactive Waste Management Ltd (2016) *Geological Disposal Generic Environmental Assessment*
[375] National Parks (2016) *National park facts and figures.* Available online at: http://www.nationalparks.gov.uk/learningabout/whatisanationalpark/factsandfigures
[376] National Association of AONBs (2017) *Areas of Outstanding Natural Beauty*. Available online at: http://www.landscapesforlife.org.uk/
[377] Natural England (2014) *National Character Area profiles: data for local decision making*. Available online at: http://www.naturalengland.org.uk/ourwork/landscape/englands/character/areas/default.aspx

The boundaries of the NCAs are not precise and many should be considered as broad zones of transition. Natural England have rewritten and redesigned all of England's 159 NCA profiles and published the revised profiles in September 2014. The NCAs are defined by a unique combination of landscape, biodiversity, geodiversity, history, and cultural and economic activity.

Heritage Coasts are areas defined (they are not statutorily designated) for the beauty and undeveloped nature of the coastline. They represent 1,057km of England's coastline and are managed to conserve their natural beauty and, where appropriate, to improve accessibility for visitors. Most Heritage Coasts are within the boundaries of National Parks or AONBs, although some including Lundy, the Durham Coast, and Flamborough Head stand alone[378].

A national record of over 1,600 Registered Historic Parks and Gardens[379] which contribute to the landscape is maintained by Historic England. It is a non-statutory designation but the designation is a material planning consideration.

There are 18 World Heritage Sites in England, including Blenheim Palace. In 2017, the Lake District was the most recent site in England to be inscribed to the World Heritage Site list under the category of Cultural Landscape.

Scotland

Scottish Natural Heritage identified a series of Natural Heritage Zones as part of their Natural Heritage Futures initiative, and used these areas to describe a vision for sustainable use of local natural heritage. A total of 21 zones were identified[380], each having their own identity resulting from the interaction of geology, landforms, wildlife and land use.

Scotland has 40 National Scenic Areas (NSAs) covering more than one million hectares (12.7% of Scotland). The Planning etc. (Scotland) Act 2006 gives a statutory basis to NSAs. The purpose of the NSA designation is both to identify our finest scenery and to ensure it is protected from inappropriate development. This is achieved through the local authority planning system[381]. Other areas designated for their landscape include two National Parks and three Regional Parks together with a number of Special (local) Landscape Areas[382].

There are six World Heritage Sites in Scotland: The Forth Bridge, St. Kilda; Old and New Towns of Edinburgh; the Frontiers of the Roman Empire (partially also in England); Heart of Neolithic Orkney; and New Lanark[383].

The Scottish Government's third National Planning Framework, published in June 2014, recognises wild land as a "nationally important asset", and indicates Scotland's wildest landscapes merit strong protection. Scottish Natural Heritage published a new map of wild land

[378] Natural England (2006) *Review and evaluation of heritage coasts in England*. Available online at: http://publications.naturalengland.org.uk/publication/4594438590431232?category=56001
[379] Historic England (2017) *Registered Parks & Gardens*. Available online at: https://historicengland.org.uk/listing/what-is-designation/registered-parks-and-gardens/
[380] Scottish Natural Heritage (2002) *Natural Heritage Zones: A National Assessment of Scottish Landscapes*. Available online at: http://www.snh.org.uk/futures/Data/pdfdocs/LANDSCAPES.pdf
[381] Scottish Natural Heritage (2017) *National Scenic Areas.* Available online at: http://www.scotland.gov.uk/Resource/Doc/1051/0095735.pdf
[382] The term used for such local landscape designations varies from one local authority to another. For example, they are currently termed ''Areas of Great Landscape Value' in Moray, 'Special Landscape Areas' in Dumfries and Galloway, and 'Sensitive Landscape Character Areas' in Ayrshire. However, guidance published by Scottish Natural Heritage and Historic Environment Scotland suggests the name be standardised to Special Landscape Area (SLA)
[383] UNESCO (2017) *Properties inscribed on the World Heritage List for Great Britain and Northern Ireland*. Available online at: http://whc.unesco.org/en/statesparties/gb

areas in June 2014[384]. 'Wildness' in this context depends on four physical attributes, namely: the perceived naturalness of the land cover; the ruggedness of the terrain which is therefore difficult to cross; remoteness from public roads or ferries; and the visible lack of buildings, roads, pylons and other modern artefacts.

Wales

There are five AONBs in Wales, one of which straddles England and Wales (the Wye Valley AONB)[385]. Other areas designated for their landscape include three National Parks covering 20% of Wales (Brecon Beacons, Snowdonia and Pembrokeshire Coast National Park); 495km of Heritage Coast, and 58 landscapes of outstanding/special historic interest.

There are three World Heritage Sites in Wales; Castles and Town Walls of King Edward in Gwynedd, Blaenavon Industrial Landscape and Pontcysyllte Aqueduct & Canal.

Summary of Existing Problems Relevant to the Geological Disposal NPS

The following existing problems for landscape have been identified:

- Over the last century the following landscape character trends have been experienced in the UK[386]:
  - a gradual erosion of local distinctiveness in some areas;
  - a loss of some natural and semi-natural features and habitats such as ancient woodlands and unimproved grassland;
  - a decline in some traditional agricultural landscape features such as hedgerows, and a loss of archaeological sites;
  - increased urbanisation; and
  - a loss of remoteness and reduced tranquillity because of built development and traffic growth.
- Light pollution appears to have increased considerably over the last 30-40 years over much of the UK. The growth of urban areas, road networks and industrial areas are all major contributors to increased light levels.
- Natural England reported that in 2008, existing landscape character was being maintained in 51% of England's landscapes, whilst in a further 10%, existing character was being enhanced. For 19% of areas, new landscape characteristics were emerging, whilst the remaining 20% showed some signs of neglect.
- Key issues that could affect England's landscape could include the effects of climate change (and effects arising from the increased frequency and intensity of

[384] Scottish Natural Heritage (2014) *Mapping Scotland's wildness and wild land.* Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/looking-after-landscapes/landscape-policy-and-guidance/wild-land/mapping/
[385] Visit Wales (2017) *Areas of Outstanding Natural Beauty*. Available online at: http://www.visitwales.com/explore/areas-of-outstanding-natural-beauty/natural-beauty
[386] Natural England (2008) *State of the Natural Environment 2008*. Available online at: http://publications.naturalengland.org.uk/publication/31043

storm and flood events, increased likelihood of droughts and the anticipated increased in wildfires), changes to agricultural practices, new energy infrastructure and development pressures.

- The Scottish landscape is vulnerable to a variety of pressures. Key threats and opportunities to landscape character include the development of new infrastructure, agriculture, the loss and expansion of woodland and natural processes.
- In Wales, changes in weather patterns and soil conditions will alter the vegetation that is an important landscape feature. Climate change can also have an effect on flooding or increases in temperatures may also present challenges for the landscape. Coastal areas may be most at risk. Responses to changing climate such as the introduction of new crops and land uses will also have an impact on the visual appearance of the landscape.

Likely Evolution of the Baseline

England

There are a number of pressures and risks outlined in the ***State of the Natural Environment 2008*** Report that may affect the quality of landscapes in England. These include:

- Sea-level rise: Over the next few decades it is anticipated that there will be major sea incursions inland during storms, particularly on the south and east coasts of England. If measures such as managed retreat are not adopted in low-lying areas, there may be widespread losses of intertidal and coastal habitats. In the coastal zone, sea-level rise may also result in the direct loss of freshwater habitats such as reedbeds and wet grasslands;
- Fire: More droughts in the future will make the countryside increasingly vulnerable to wildfire, with potential for heathland, grassland, broadleaved woodlands and bogs to undergo major change in their structure;
- Grazing management: More summer droughts may mean that grazing is no longer possible in some open habitats such as fens, grasslands and heathlands due to die-back of vegetation and a lack of drinking water for animals. The spread of diseases (e.g. bluetongue) related to climate change may also reduce livestock numbers and restrict movement, altering grazing patterns and landscapes;
- Energy production: The production of biofuels in the countryside may result in changes to landscapes. Wind energy developments are likely to be more common; and
- Development pressure: Within rural England, the area of developed land has increased by about 4% since 1990. It is expected that the pace of development within England will increase in the future to make up for the current shortfall in housing provision. The effect of this increase pressure for development is likely to be felt most acutely in central and southern England where demand for housing is greatest.

Natural England report that in 2008, existing landscape character was being maintained in 51% of England's landscapes, whilst in a further 10%, existing character was being enhanced. However, 20% of landscapes were showing signs of neglect, while in the remaining 19% new landscape characteristics are emerging.

Data from 1990 to 2003 indicates that in England the number of Character Areas with patterns of change that either maintain or enhance character has increased from 36% to 61%. The number of Character Areas with evidence of neglect or erosion of character has decreased. This evidence suggests that the character of the majority of English landscapes, at Character Area scale, is being sustained.

The protected nature of National Park and AONB landscapes make it less likely that these landscapes will be affected by some of the risks outlined above (e.g. development pressure) although those protected landscapes nearest to existing urban areas are more likely to be at risk.

Scotland

Between 1994 and 1999 Scottish Natural Heritage, in partnership with others, commissioned a series of LCA studies that together cover the whole of Scotland. The national suite of LCAs is now over 15 years old. Scottish Natural Heritage is reviewing Scotland's LCA studies, at character type level, to create a single dataset in an interactive digital version to be hosted on the new SNH website. It is understood that by late 2017 the revised LCAs will be available, providing further clarity on the long-term trends[387].

Wales

The changing climate will have an effect on Wales' distinctive landscapes and seascapes. Changes in weather patterns and soil conditions will alter the vegetation that is an important landscape feature. Climate change can also have an effect on flooding or increases in temperatures may also present challenges for the landscape. Coastal areas may be most at risk. Responses to changing climate such as the introduction of new crops and land uses will also have an impact on the visual appearance of the landscape.

Assessing Significance

The objectives and guide questions related to landscape which have been identified for use in the appraisal of the effects of Geological Disposal Infrastructure NPS proposals and alternatives are set out in **Table 13.1**, together with reasons for their selection.

Table 13.1 Approach to Assessing the Effects of the Geological Disposal Infrastructure NPS Landscape and Townscape

Objective/Guide Question	Reasoning
Objective: To protect and enhance landscape and townscape quality and visual amenity.	The SEA Directive (2001/42/EC) requires that the likely significant effects on landscape should be taken into account in the Environmental Report, which for the purposes of the AoS is incorporated within the AoS Report.
Will the Geological Disposal Infrastructure NPS have significant visual impacts (including those at night)?	Visual impacts can influence how people perceive a landscape or townscape and can decrease the character and intrinsic value.

[387] Scottish Natural Heritage (2017) *Landscape Character Assessment*. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/looking-after-landscapes/lca/

Objective/Guide Question	Reasoning
Will the Geological Disposal Infrastructure NPS affect protected/designated landscapes or their setting?	Areas designated for their landscape value are important at a national level and should be protected from adverse effects and enhanced where possible.
Will the Geological Disposal Infrastructure NPS affect the intrinsic character or setting of local landscapes or townscapes?	Considering the protection and enhancement of landscape and townscape character is a requirement of the NPPF, SPP and PPW.
Will the Geological Disposal Infrastructure NPS help to minimise light pollution from construction and operational activities on residential amenity and on sensitive locations and receptors?	The consideration of light pollution is a requirement of the NPPF and PPW.
Will the Geological Disposal Infrastructure NPS affect public access to open spaces or the countryside?	National Parks and Access to the Countryside Act 1949 and Countryside and Rights of Way Act 2000 make provision for the recording, creation, maintenance and improvement of public paths and for securing access to open country and confers further powers for preserving and enhancing natural beauty.

Table 13.2 sets out guidance that has been utilised during the assessment to help determine the relative significance of potential effects on the landscape objective.

Table 13.2 Illustrative Guidance for the Assessment of Significance for Landscape and Townscape

Effect	Description	Illustrative Guidance
++	Significant Positive	• Option would make a significant positive contribution to statutorily-designated landscapes and/or their setting; • Option would have a significant positive effect on local landscapes and townscapes and/or their setting (e.g. through the replacement of poorly designed/derelict buildings with high quality development); • Option would enhance public access to the countryside and increase open space provision.
+	Positive	• Option would serve to enhance statutorily-designated landscapes and/or their setting; • Option would have a positive effect on local landscapes and townscapes and/or their setting; • Option would enhance public access to open spaces and the countryside.
0	Neutral	• Option would not have any effect on statutorily-designated landscapes or their setting; • Option would not have any effects on local landscapes and townscapes or their setting • Option would not affect visual amenity; • Option would not enhance or restrict public access to open spaces and the countryside.
-	Negative	• Option would have short-term negative effects on statutorily-designated landscapes and/or their setting;

Effect	Description	Illustrative Guidance
		• Option would have a negative effect on the intrinsic character of local landscapes and townscapes and/or their setting; • Option would affect the visual amenity of local communities; • Option would temporally restrict public access to open spaces and the countryside.
--	Significant Negative	• Option would have long-term negative effects on statutorily-designated landscapes (such as AONBs) and/or their setting; • Option would severely affect the intrinsic character of local landscapes and townscapes and/or their setting; • Option would severely affect the visual amenity of local communities; • Option would result in the loss of open spaces and restrict public access to the countryside.
?	Uncertain	• From the level of information available the effect that the option would have on this objective is uncertain.

Appraisal of the Sustainability Effects of the Draft NPS and Reasonable Alternatives

Table 13.3 presents the appraisal of the likely significant effects of the draft NPS and the following reasonable alternatives: 'Draft NPS including exclusionary criteria[388]' and 'No NPS' on the landscape objective. The appraisal considers in-turn the three sub-sections used for each topic within Chapter 5 (Impacts) of the draft NPS: Applicant's Assessment; Decision Making (subdivided into specific areas of interest) and Mitigation. The performance of the draft NPS and the two reasonable alternatives are scored accordingly, with a commentary provided in the "Appraisal" column. Commentary is also provided on Chapters 1 – 4 of the draft NPS outlining how the remainder of the NPS could affect the appraisal topic. The overall effect of the draft NPS and the two reasonable alternatives is then summarised along with any proposed mitigation measures.

The draft NPS identifies a timescale of 15 - 20 years for site characterisation and an operational period of approximately 150 years covering construction and waste emplacement. These timeframes inform the likely timing of effects covered by this appraisal which are: ST – short-term (less than 20 years), MT – medium-term (between 20 and 170 years) and LT – long-term (>170 years). The appraisal also reflects the four phases of facility development, namely: site investigation, construction, operation and closure.

[388] Exclusionary criteria are those criteria which, when applied, would ensure that any geological disposal infrastructure development could not take place within an area or site possessing certain prescribed characteristics. The specific criteria proposed are for landscape, cultural and natural heritage assets of international and national significance

Table 13.3 Appraisal of the Draft NPS and Reasonable Alternatives: Landscape and Townscape

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Applicant's Assessment	+	++/?	+/?	**Draft NPS:** The text provides clear guidance, and reference to more detailed external guidance, on how landscape and visual impacts should be taken into account. Reference is made to the role of existing studies in helping to determine the context within which the development could or will take place, the diversity of considerations associated with landscape (visual amenity, tranquillity, historic landscapes) and the importance of considering the likely effects associated with the different project stages. The draft NPS also identifies that any application for development consent that could affect landscapes of national significance (such as National parks and AONBs and which cover around one quarter of England and Wales) will need to comply with the provisions of the (identified) relevant legislation. The provisions of the draft NPS should lead to positive effects, reflecting the balancing of impacts with a site and design-specific need case. *Recommendations for Improvement* The text could make direct reference to the Planning Practice Guidance on how landscape matters should be dealt with as part of a development consent application (PPG Natural Environment - Landscape (Paragraph: 001 Reference ID: 8-001-20140306). Inclusion of specific guidance on the likely contents of the Environmental Statement would be helpful in clarifying the expectations for the Applicant's Assessment. In line with national guidance[389], key issues to be addressed should include: • Consideration of the sensitivity of landscape character and views to change, and on the magnitude of change likely to occur. • Criteria for identifying the sensitivity of different landscape and visual receptors to change. It will identify the key landscape and visual receptors and ascribe sensitivity to each receptor. • Conclusions on the significance of any effects that are predicted upon landscape features and character or on visual amenity. • Mitigation measures such as through avoidance of impact through site planning and design will be the preferred and primary mitigation strategy for the avoidance of adverse landscape impacts. Amend final sentence of para 5.10.2 to read: "…policies based on these assessments in local development plans in England."
				Draft NPS including Exclusionary Criteria: The effect of this reasonable alternative is likely to be significantly positive, reflecting the setting of clear parameters for siting which excludes specific landscape assets. This goes beyond the guidance in the draft NPS to the Examining Authority and the Secretary of State in which "*great weight should be given to conserving landscape and scenic beauty in nationally designated areas*" but which does not provide the certainty that exclusionary

[389] Guidelines for Landscape and Visual Impact Assessment, Landscape Institute and Institute of Environmental Assessment and Management, Third Edition, 2013; Landscape Assessment Methodology, Design Manual for Roads and Bridges (DMRB), Highways Agency, 1993; and Interim Advice Note 135/10: Landscape and Visual Effects Assessment Interim Advice Note, Highways Agency, 2010

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				criteria would provide. However, simply excluding works from within a designated landscape such as a National Park or AONB would not necessarily exclude the possibility of adverse effects on the setting of such assets (although the general risk of adverse effects is assumed to be reduced). In particular, adverse effects on the setting of designated landscapes could still arise if geological disposal facilities were sited adjacent or close to the boundary of a site, although it would be expected that the significance of any such effects could be reduced through the implementation of appropriate mitigation such as good design and consideration of layout. There is also the potential for unintended effects to be produced as a consequence of greater development pressure on areas/landscapes not afforded such high levels of protection. Whilst this is currently uncertain, given existing policy and legislation on landscape, as well as the requirements of the draft NPS, such unintended effects are considered to be unlikely to occur. It is important to note that existing national planning policy and legislation, together with the requirements of the draft NPS (as proposed), provide for the protection of designated landscapes such as National Parks such that it can be reasonably expected that the potential for adverse impacts in this regard would be fully considered at the project stage. Even where there is the potential for adverse impacts to arise as a result of the development of geological disposal infrastructure, in many cases it is likely that these impacts could be avoided, minimised or mitigated through, for example, design measures (and in accordance with the provisions of the draft NPS).
				No NPS: Applications would be subject to the provisions of national planning policy, specific statutory requirements concerning effects on nationally designated landscape (Section 11A of the National Parks and Access to Countryside Act 1949 and Section 85 of the Countryside and Rights of Way Act 2000) and EIA Regulations under this alternative, and would therefore still be considered likely to have a positive effect. However, the absence of a clear statement of the full range of considerations to be taken into account (as proposed in the draft NPS) risks inconsistency in interpretation, particularly at a project level, hence uncertainty over the likely effect.
Decision Making				
Landscape Character Impact	**+**	**++/?**	**+/?**	**Draft NPS:** The specific requirement that impacts on landscape character, quality, capacity and sensitivity are considered as part of the siting, construction and operation of a facility will ensure that the interests of the receiving landscape context receive attention as part of the design process. The effects of the draft NPS are likely to be positive given that any impact will sought to be minimised and mitigated (such as through landscape enhancement).
				Draft NPS including Exclusionary Criteria: The use of exclusionary criteria to avoid siting of geological disposal infrastructure in landscapes of particular sensitivity is likely to result in significant positive effects through establishing clear parameters for decision making. However, as noted above, simply excluding works from within a designated landscape such as a National Park or AONB would not necessarily exclude the possibility of adverse effects on the setting of such assets (although the general risk of adverse effects is assumed to be reduced). In particular, adverse effects on the setting of designated landscapes could still arise if geological disposal facilities were sited adjacent or close to the boundary of a site,

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				although it would be expected that the significance of any such effects could be reduced through the implementation of appropriate mitigation such as good design and consideration of layout. There is also the potential for unintended effects to be produced as a consequence of greater development pressure on areas/landscapes not afforded such high levels of protection. Whilst this is currently uncertain, given existing policy and legislation on landscape, as well as the requirements of the draft NPS, such unintended effects are considered to be unlikely to occur. It is important to note that existing national planning policy and legislation, together with the requirements of the draft NPS (as proposed), provide for the protection of designated landscapes such as National Parks such that it can be reasonably expected that the potential for adverse impacts in this regard would be fully considered at the project stage. Even where there is the potential for adverse impacts to arise as a result of the development of geological disposal infrastructure, in many cases it is likely that these impacts could be avoided, minimised or mitigated through, for example, design measures (and in accordance with the provisions of the draft NPS).
				No NPS: Applications will be subject to the provisions of national planning policy, statutory requirements and EIA and therefore will take landscape considerations into account. However, the absence of a clear statement on the expectations for addressing landscape issues through survey, design and appropriate mitigation (i.e. as per the Guidelines for Landscape and Visual Impact Assessment) could result in a degree of doubt and inconsistency in interpretation, particularly at the project level.
Development proposed within nationally designated areas & developments outside nationally designated areas which might affect them	**+/?**	**++/?**	**+/?**	**Draft NPS:** The draft NPS directs the SoS to place great weight on the importance of conserving nationally significant landscapes and as such the effects are likely to be positive. However, impact will be balanced against issues of need, cost and opportunities for moderation of impacts and the draft NPS notes the circumstances in which the SoS may grant development consent which "impacts the natural beauty of the landscape and countryside in these areas in exceptional circumstances". Where consent is given, the SoS should be satisfied that the applicant has ensured that the project will be carried out to high environmental standards. As such there could be a degree of uncertainty as to the likely outcomes (in terms of effects on the landscape) of this balancing exercise.
				Draft NPS including Exclusionary Criteria: Specification of exclusionary criteria which clearly protect nationally important landscapes will result in significantly positive effects for landscape interests, although there are likely to be uncertainties associated with potentially greater pressure placed on areas peripheral to the excluded areas and/or local assets not given specific protection.
				No NPS: National planning policy, statutory requirements and EIA Regulations will apply requiring a balanced decision making exercise, resulting in neutral outputs. However, there is likely to be a degree of uncertainty as to the nature and extent of these effects, being dependent upon the interpretation of national policy at a project level on a case-by-case basis.
Developments	**0**	**+/?**	**0/?**	**Draft NPS:** Acknowledgement of potential effects on areas not specifically designated for their landscape value is likely to

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
in other areas				result in neutral effects reflecting the balancing of need and impact in decision making.
				Draft NPS including Exclusionary Criteria: The use of exclusionary criteria could place additional pressure on peripheral landscapes as siting options potentially become significantly reduced. Thus whilst expectations for the consideration of landscape impacts is clearer, there could be unintended consequences for landscapes which are not deemed to be special.
				No NPS: National planning policy, statutory requirements and EIA Regulations will apply requiring a balanced decision making exercise, resulting in neutral outputs. However, there is likely to be a degree of uncertainty as to the nature and extent of these effects, being dependent upon the interpretation of national policy at a project and on a case-by-case basis.
Visual impact	**+/?**	**+**	**+/?**	**Draft NPS:** Significant weight is accorded to the judgement of the Secretary of State, as principal decision maker, on the likely visual effects of development. As part of this balancing exercise the interests of landscape will be taken into account in the light of the national guidance, thus producing positive effects, although their weight against other material considerations can only be determined on a site-by-site basis thus resulting in a degree of uncertainty.
				Draft NPS including Exclusionary Criteria: Significant weight is accorded to the judgement of the Secretary of State, as principal decision maker, on the likely visual effects of development. As part of this balancing exercise the interests of landscape will be taken into account in the light of the national guidance, thus producing positive effects. The use of exclusionary criteria should help to accord greater certainty as to where and how this balancing exercise will need to be applied.
				No NPS: National planning policy and EIA Regulations will apply requiring a balanced decision making exercise, resulting in broadly positive effects overall. However, there is likely to be a degree of uncertainty as to the nature and extent of these effects, being dependent upon the interpretation of national policy at a project level and on a case-by-case basis.
Mitigation	**+/?**	**+/?**	**+/?**	**Draft NPS:** The proposed mitigation sets out the broad expectations associated with the lifecycle of a GDF, many of which are contingent upon the specific site being investigated or selected. This should result in positive effects but they are uncertain because of the issues which may arise because of site-specific conditions and hence how landscapes might be interpreted and mitigated.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Recommendations for Improvement The mitigation could be revised to be more specific and clearly reflect the potential effects associated with the key project stages of site investigation, construction, operation and closure, as follows[390]: *Site Investigation* Borehole drilling has the potential to create the following adverse effects, although the realisation of this potential would be very dependent on the detailed planning of the works and on the characteristics of the locality: • Fragmentation/loss of landscape features affecting landscape character, particularly as a result of the construction of access routes etc.; • Introduction of new elements into existing views would have negative visual effects, e.g. erection of the drilling rigs and bunding around the site; and • Light pollution effects from 24-hour lighting. Based on a current understanding, it is thought likely that drilling works would last approximately 6 months at any single location and it is expected that two drilling rigs would operate simultaneously within a target area of 10 km^2. Some equipment would be left in place for testing and monitoring purposes. Therefore, in general these effects would be temporary and there is high potential for mitigation through reinstatement of the land and of any trees, hedgerows etc. that have been lost or damaged. Mitigation could therefore involve: • Effective engagement with communities to identify valued features; • Avoidance where possible of the removal of landscape features; • Design to minimise adverse effects on visual amenity; • Avoidance/minimising lighting where possible, consistent with security requirements; • Planning work to facilitate site restoration, including aftercare; • Following good practice in the protection, management and restoration of soils; • Development and implementation of an Environmental Management Plan. *Construction*

[390] Derived from: Radioactive Waste Management Ltd (December 2016) *Geological Disposal Generic Environmental Assessment*

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				Surface construction activities have the potential to result in the following adverse effects: • Fragmentation or loss of key landscape elements and potentially significant change to local landscape character; • Potentially significant visual intrusion; and • Improved or new rail and/or road infrastructure, introduction of new visual elements, removal of surplus excavated rock from site and 24-hour lighting could all adversely affect landscape character and visual amenity. Depending on the nature of the geology of the host rock formation of the proposed GDF, surface bunds to store excavated material may need to be created. Surface bunds can have two effects on landscape: • They help to screen views of visually intrusive features, and provide a platform for tree and shrub planting to further enhance visual screening. Sufficient height is required to provide effective screening, and sufficient width to provide a platform for planting; and • Excessively high bunds can be visually intrusive in their own right (although usually less so than the features they screen), unless carefully designed and effectively integrated into the landscape. Any bunding and associated tree planting will have to be designed to reflect both visual containment and the requirements of nuclear site security in respect of ensuring that there are clear sight lines. Should any new ancillary infrastructure be required (such as freight transfer facilities or port facilities), the landscape and visual effects of this would require separate assessment. Mitigation could therefore involve the following, in addition to the continuation of the above proposed mitigation measures: • Consider landscape/visual effects in site selection and design, with any mitigation designed to be in character with the local landscape and the requirements of site security; • Minimise footprint and adjust layout of surface facilities and infrastructure; • Consider both on and off site landscape and planting works; • Consider landscape works in an integrated way with ecology/biodiversity mitigation; • Construction phase environmental management plan(s); • Establish temporary screening at outset and replace with longer-term landscape bunding and planting to screen views of site and integrate into landscape, subject to the requirements of site security • Establish planting as early as possible to maximise its effectiveness and use locally-sourced native tree and shrub species. *Operation* Surface facilities/infrastructure could have the following long-term effects:

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				• Visual intrusion and effects on landscape character due to permanent surface facilities, ongoing storage and movement of excavated rock as underground excavation would continue; • Adverse visual effects due to lighting for operational, safety and security purposes; • Surface bunds, visual screening and any other mitigation would have become more established, reducing landscape and visual effects; and • As no improvements to the rail/road/sea infrastructure are anticipated outside the construction phase no further negative effects are envisaged. Depending on the nature of the geology of the host rock formation of the proposed GDF, some rock would be stored in bunds as a stockpile for use in backfilling during the operational period, whereas this would not occur on other host rock types. This may give rise to additional visual intrusion due to the presence of bunds that are periodically disturbed, replenished and depleted. As waste is transferred to a GDF from existing NDA sites, existing storage facilities can be dismantled, removing what would otherwise be long-term visually intrusive features from the landscape at multiple rural locations scattered throughout England and Wales. Mitigation could therefore involve the following, in addition to that identified above, where appropriate: • Operational phase environmental management plan(s); • Periodic review and update of environmental management plan(s) throughout operations; • Landscape/visual mitigation and enhancements to be progressed and a long-term maintenance plan established and implemented; • Preserve visual integrity of outermost bunds providing visual screening, using bunds further into the interior for rock storage/handling; • Avoid lighting outer perimeter fence. Careful design of lighting of inner security fence and lighting of active areas to minimise light spillage. *Closure* Potential adverse visual effects could occur during the following activities: • Surface support for backfilling, sealing and closure of underground facilities; and • Closure, decommissioning and demolition of surface facilities. These would be of a similar, or lesser, scale and nature as above and it is assumed any visual screening and enhancements would be well established reducing potential effects. Post decommissioning, the site would be restored to as near its pre-construction condition as practicable, or an alternative end-state agreed with the local community. Visually intrusive features associated with a GDF would have been removed, while there is the potential for some or all of the beneficial features, such as the landscape mitigation established during the lifetime of a GDF, to be left in place. A proportion of the surface bunds

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
				may be left in place, where the rock of which they are formed is not required for backfilling. By this stage the surface bunds would support mature tree planting, so their retention would be beneficial. Mitigation could therefore involve: • Appropriately designed site restoration, with input from local stakeholders, taking into account the landscape context at the time of closure. • Where appropriate and possible, restoration of any landscape/habitat lost as a result of a GDF on a like-for-like or better basis, with aftercare provision. • Where appropriate, retention of mature landscape features established as part of landscape and visual mitigation during construction or operation.
				Draft NPS including Exclusionary Criteria: As above.
				No NPS: Absence of the NPS is likely to result in a positive effect due to the application of national planning policy and EIA Regulations; however, there remains a degree of uncertainty, reflecting the absence of specific direction as to the expectations associated with the lifecycle of a GDF in respect of landscape impacts.
Other Sections of the Draft NPS Relevant to Landscape	**1. Introduction** 1.1.3 There is an opportunity for the consideration of effects on landscape in a specific locality through the preparation of a local impact report submitted by a local authority in accordance with the Planning Act. There is no prescribed format for local impact reports but there is clearly an opportunity for a local authority to comment on landscape as an issue, helping to ensure that consideration is given to likely effects in a particular locality. 1.1.4 Protection of landscape interests is reflected in the need to apply the draft NPS in the context of international obligations and to balance adverse impacts and benefits. The net result of this balancing exercise could be uncertain, however. 1.1.7 The generic impacts considered in the NPS, along with the application of the draft NPS as a material consideration on a case by case basis, could result in uncertainty over what provisions will be applied in respect of the protection of landscape interests and the mitigation of adverse effects. **1.4 Consideration of deep boreholes investigations** – the role and content of an Environmental Statement, and agreement of this with statutory agencies, should help to ensure that there is proper consideration of landscape interests, avoiding or reducing impact and providing appropriate mitigation where required. **1.5 Consideration of geological disposal facilities** – the spatial disposition of facilities and the timescale of development could affect landscape interests although the requirements for limiting cumulative negative impacts within safety and reasonable financial constraints should help to minimise impacts. However the net long-term effects remain uncertain. **2. Government Policy on Management of Higher Activity Radioactive Waste** 2.2.6. The preference for disposal through a single site will help to confine effects to a specific area thus limiting effects on landscape, although these could still be significant			

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal

in respect of that particular site and surrounding area.

2.4.3 The strategy for implementation provides for the opportunity to consider landscape interests as the process proceeds iteratively, including discussions with communities of interest.

3. The Need for Geological Disposal Infrastructure

No likely effects identified.

4. Assessment Principles

4.1 General principles of assessment - the provisions of the Planning Act and the policies and protections set out in the draft NPS provide for a balanced consideration of needs. The requirement for the identification of adverse impacts (including longer-term and cumulative adverse impacts) along with measures to avoid, reduce or compensate these, provides the starting point for the protection and enhancement of landscape interests**.**

4.2 Environmental Impact Assessment – the consideration of proposals within the EIA Regulations and the preparation of an Environmental Statement (where required) agreed by statutory agencies and specifying mitigation and enhancement measures will ensure that landscape interests are fully considered, as will the consideration of cumulative effects and interrelationships between effects.

4.3 Habitats Regulations Assessment – no direct relationship identified.

4.4 Alternatives – the identification that reasonable alternatives will be required as part of scheme design and project planning should ensure that landscape interests are taken into account, both in terms of protection and opportunities for mitigation and enhancement.

4.5 Criteria for good design for geological disposal infrastructure - attention to good design principles and implementation will be of benefit to landscape interests through the consideration of how a proposed facility interacts with its context. As drafted, however, the NPS could offer a fuller explanation of how this might be achieved, moving beyond the reference points of ‘landform’ and ‘vegetation’ to the integration of landscape interests on site as part of a scheme, as well as broader mitigation measures. Attention should also be paid to the lifecycle of the scheme development and how landscape interests can be accommodated throughout, and particularly as part of site closure.

4.6 Climate Change Adaptation – adaptation measures could be required which impinge upon landscape interests although with appropriate design and mitigation measures these could be of mutual benefit (for example in relation to landscape enhancement).

4.7 Pollution Control and other Environmental Regulatory Regimes – no direct relationship identified.

4.8 Common Law Nuisance and Statutory Nuisance – no direct relationship identified.

4.9 Safety – no direct relationship identified.

4.10 Health – section assumed to be deleted in version 13 of the draft NPS – no comment.

4.11 Security Considerations – no direct relationship identified.

The effects from the draft NPS and the reasonable alternatives to it are considered to be more positive than the reasonable alternatives, reflecting the specification of expectations associated with, in particular, design criteria. As part of the design process and mitigation strategy there are important links to be made with the biodiversity and cultural heritage topics, reflecting shared space and common features such as woodland or listed buildings.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Summary Appraisal of Likely Significant Effects	+/?	++/?	+/?	**Draft NPS:** Application of the draft NPS is likely to result in positive effects in respect of the protection and enhancement of landscape interests, reflecting the specification of the parameters associated with site investigation, construction and operation of a GDF. The draft NPS framework will be applied in light of existing legislation, although this will be a balancing exercise reflecting the consideration of national need and other considerations, hence a degree of uncertainty as to the precise outcomes. Development will affect landscape interests to some degree at various points in the project lifecycle, but the draft NPS provides for the application of mitigation measures, addressing direct effects. The wider considerations of the draft NPS in respect of the assessment principles such as good design is likely to result in positive effects for landscape interests.
				Draft NPS including Exclusionary Criteria: The overall effects of the inclusion of exclusionary criteria are likely to be similar to those relating to the draft NPS, although the magnitude will be greater. This reflects the expectation that the specification of exclusionary criteria is likely to result in significant positive effects due to the certainty provided on precisely where investigation and development will and will not be permitted. Development will affect landscape interests to some degree at various points in the project lifecycle, but the draft NPS provides for the application of mitigation measures, addressing direct effects. However, the final decision is a balancing exercise reflecting the consideration of national need and other considerations, hence there will be a degree of uncertainty as the precise outcomes. The wider considerations of the draft NPS in respect of the assessment principles such as good design is likely to result in positive effects for landscape interests. Despite the benefits outlined above, simply excluding works from within a designated landscape such as a National Park or AONB would not necessarily exclude the possibility of adverse effects on the setting of such assets (although the general risk of adverse effects is assumed to be reduced). In particular, adverse effects on the setting of designated landscapes could still arise if geological disposal facilities were sited adjacent or close to the boundary of a site, although it would be expected that the significance of any such effects could be reduced through the implementation of appropriate mitigation such as good design and consideration of layout. There is also the potential for unintended effects to be produced as a consequence of greater development pressure on areas/landscapes not afforded such high levels of protection. Whilst this is currently uncertain, given existing policy and legislation on landscape, as well as the requirements of the draft NPS, such unintended effects are considered to be unlikely to occur. It is important to note that existing national planning policy and legislation, together with the requirements of the draft NPS (as proposed), provide for the protection of designated landscapes such as National Parks such that it can be reasonably expected that the potential for adverse impacts in this regard would be fully considered at the project stage. Even where there is the potential for adverse impacts to arise as a result of the development of geological disposal infrastructure, in many cases it is likely that these impacts could be avoided, minimised or mitigated through, for example, design measures (and in accordance with the provisions of the draft NPS).
				No NPS: In the absence of the draft NPS, national planning policy and EIA Regulations will provide likely positive effects overall; however, with some uncertainties reflecting the absence of clear expectations as to siting and design relating the specific case of a GDF as well as uncertainty and inconsistency in their application. The precise range of mitigation applied as part of any scheme development would potentially be less certain and with greater inconsistency than under a NPS.

NPS Sub-section	Draft NPS	Draft NPS incl. Excl Criteria	No NPS	Appraisal
Summary of Recommended Mitigation and Enhancement	The mitigation measures proposed by the draft NPS broadly reflect the issues considered as part of the conditions attached to any application. However, they could more fully reflect the specification set out in the Applicant's Assessment and Decision Making Criteria and relate more specifically to project stages (site investigation, construction, operation & closure) and thereby the likely specific impacts associated with a development of this nature. These would establish a clear specification for use by applicant and appraisal by the competent authority. Equally, there could be more attention paid to specific design principles associated with the project lifecycle and by implication the mitigation measures which can reasonably be applied.			