Radioactive Waste Management

NDA Report no. DSSC/332/01

Geological Disposal

Generic Socio-economic Assessment

December 2016

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Preface

Radioactive Waste Management Limited (RWM) has been established as the delivery organisation responsible for the implementation of a safe, sustainable and publicly acceptable programme for the geological disposal of the higher activity radioactive wastes in the UK. As a pioneer of nuclear technology, the UK has accumulated a legacy of higher activity wastes and material from electricity generation, defence activities and other industrial, medical and research activities. Most of this radioactive waste has already arisen and is being stored on an interim basis at nuclear sites across the UK. More will arise in the future from the continued operation and decommissioning of existing facilities and the operation and subsequent decommissioning of future nuclear power stations.

Geological disposal is the UK Government's policy for higher activity radioactive wastes. The principle of geological disposal is to isolate these wastes deep underground inside a suitable rock formation, to ensure that no harmful quantities of radioactivity will reach the surface environment. To achieve this, the wastes will be placed in an engineered underground facility – a geological disposal facility (GDF). The facility design will be based on a multi-barrier concept where natural and man-made barriers work together to isolate and contain the radioactive wastes.

To identify potentially suitable sites where a GDF could be located, the Government has developed a consent-based approach, based on working with interested communities that are willing to participate in the siting process. The siting process is on-going and no site has yet been identified for a GDF.

Prior to site identification, RWM is undertaking preparatory studies which consider a number of geological environments and a range of illustrative disposal concepts. As part of this work, RWM maintains a generic Disposal System Safety Case (DSSC). The generic DSSC is an integrated suite of documents which together give confidence that geological disposal can be implemented safely in the UK.

Executive Summary

UK Government policy for the long-term management of higher activity waste is 'geological disposal', a solution to radioactive waste management that will be safe in the long-term without dependence on ongoing human intervention.

The process of siting and constructing a geological disposal facility (GDF) is likely to take several decades and, once a facility is operational, it is likely to operate for more than a century. At the end of this period the facility will be closed and all the radioactive waste will remain sealed hundreds of metres below ground, with no harmful quantities of radioactivity ever returning to the surface.

To identify potential sites where the GDF can be located, the UK Government and devolved administrations favour a consent-based approach, working with communities that are willing to participate in the siting process. The site selection process has not yet been undertaken so this report considers generically the implementation of the GDF within England, Wales or Northern Ireland. Scotland is not included as it is Scottish Government policy that the long-term management of higher activity waste should be in near-surface facilities located as near to the site where the waste is produced as possible.

This report considers in generic terms the socio-economic effects that development of the GDF may have on the local area and community hosting it. 'Generic' in this context reflects the fact that the assessment is not location-specific. Effects have been considered for each phase of the life cycle of the GDF, which can be summarised as:

- siting process, including intrusive, surface-based investigation (boreholes)
- initial construction prior to waste emplacement, including underground-based investigation
- operation (waste emplacement), including ongoing construction of additional disposal areas as they are required
- closure

At this stage it has not been possible to determine in detail the likely extent and nature of socio-economic effects as they will be dependent on the location of the GDF, the characteristics of the host community and local economy, and detailed design and mitigation[1] proposals. However, a range of potential effects, both beneficial and adverse has been identified, along with a series of generic measures and actions that could be adopted to enhance/mitigate these effects. More detailed, location-specific assessment work will be carried out during the siting process.

In general terms, the GDF will significantly enhance the socio-economic well-being of a host community. The GDF will be a multi-billion pound project, providing direct employment for hundreds of people over many decades. There will also be spin-offs associated with investment in infrastructure and the use of local service industries that will support the facility and its workforce – in terms of both additional jobs and economic investment.

The UK Government is also committed to additional, long-term investment in a host community, to help contribute to the development of its social and economic well-being and in recognition of the essential service it would be providing to the nation. To help anchor potential socio-economic benefits in the local community, to ensure they reflect community aspirations and have an enduring effect, such investment will be linked to socio-economic

[1] 'Mitigation' in this sense is anything which avoids, reduces, remedies or compensates for an adverse effect.

assessments that the developer will undertake early in the siting process. The assessments might, for example, identify a need to invest in education and skills programmes.

The potential environmental and health effects of the GDF are covered in parallel assessments. However, their respective links to socio-economic effects are considered in this assessment.

Key conclusions arising from the generic Socio-economic Assessment are set out below.

Employment

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 the GDF. Of these, 500 – 600 will be direct FTE jobs, for instance people directly employed in the siting, 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). With implementation of initiatives to support development of the local skill base, 500 - 700 of the total (direct, indirect and induced) FTE jobs could be available at a local (district) level. For most local communities this would represent a significant socio-economic gain. Enhancement and mitigation measures that could be introduced to support local employment gains might include a Workforce Development Strategy and implementation of skills and training programmes to up-skill local people for particular jobs.

Property values and blight

It is difficult to predict what the actual effect of the GDF on property values might be. To help address this, in 2015 RWM commissioned a review of the impact of various infrastructure projects on property values. The projects studied included a range of nuclear and non-nuclear facilities. The review concluded the following.

- The initiation of the site selection process and the subsequent announcement of a chosen location for the GDF are likely to result in a perception that property values will be at risk.
- An actual negative effect on property values is considered unlikely. If such an adverse effect does occur then it is likely to be relatively modest, short term and confined to an area within a few kilometres of a proposed site.
- A positive effect on property values is considered likely once a facility is constructed and operating, driven by an influx of skilled workers and an increased demand for local housing.
- The scale and extent of any negative effect is likely to be less in relatively remote and sparsely populated areas.
- The probability of a positive effect on values will be increased if the facility is located in an area with limited employment opportunities.

Economic development

Economic development in this context refers to the changes in an economy associated with the introduction of the GDF. 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).

There are several potential enhancement measures that could help to ensure a local host community makes the most of economic development opportunities through supporting and building links with local companies in the supply chain and encouraging inward investment.

Tourism

Analysis of other similar projects indicates that the GDF is likely to have a positive effect on business tourism. The tourism analysis suggests that at a local (district) level, the total spend from business tourism associated with the construction and operation of the GDF might be between £6.7 million and £13.3 million (undiscounted).

In terms of leisure tourism, it is more difficult to predict likely effects. Based on assumptions from international studies on waste management projects, there could be adverse effects on the local leisure tourism industry. However, much will depend on the characteristics of the existing tourist industry and the measures that additional funding might support to attract visitors to the area.

Agricultural sales

A study conducted in the UK for Hinkley Point C (HPC) and several studies of nuclear facilities in Switzerland, Sweden, Finland and Canada, have shown that there is little tangible evidence that such facilities have either adverse or beneficial effects on nearby agricultural businesses.

Any effects on sales would be related to a perceived change in characteristics of the area such as loss of purity or a change in quality. Research conducted on branding effects associated with the recent siting process in Cumbria and the Lake District suggests that pre-emptive planning and quick and decisive communications strategies may be important in helping to ensure brand protection and in minimising the potential for adverse effects on agricultural sales.

Social services and infrastructure

Social and public services are designed to serve families and individuals in the community, address health and emergency service needs and provide support in maintaining personal well-being. Throughout the lifecycle of the GDF, demand on local community services will be likely to increase slightly. At a very local level the effects may be significant.

The provision of leisure, sports, recreation and health facilities for workers could be part of the mitigation and enhancement measures proposed for the GDF. These measures could also be supplemented by health, education or public service programmes funded by additional community investment.

Social stability and community cohesion

Community cohesion refers to peoples' sense of belonging to a community and whether or not the community is considered a social asset. The long lengths of residency and relatively low levels of regional mobility in the UK indicate a general satisfaction with community life in most areas.

Given the long-term nature of the project it is possible that, over time, the GDF will contribute positively to community cohesion. It will, for example, provide long-term, stable employment for hundreds of people and help to develop a distinctive sense of place. Some studies have suggested that 'nuclear communities' can develop a strong sense of social cohesion and community pride.

Potential adverse effects on community cohesion could be addressed by mitigation measures such as the development of a public outreach strategy to address health and

safety concerns and a community integration plan to help GDF employees relocating to the facility to integrate with the local community.

Housing and accommodation requirements

The GDF will involve an influx of temporary and permanent workers to the host community. The highest employment is expected during the initial construction phase of the facility, prior to first waste emplacement when it is estimated that there will be over 1,000 people working on the project during peak times, with about 800 based 'on-site'. Given the generic nature of this assessment it is not possible to estimate how many of the workers will require additional housing and accommodation and how many could be housed within existing stock. More detailed assessments at a community and site-specific level will be undertaken during the siting process.

Preparation of an accommodation strategy that takes into account possible commuting times and provision of onsite accommodation for workers could be considered as a potential mitigation measure.

Distribution of effects

Major infrastructure projects do not affect all segments of society in a uniform way. Certain groups are more vulnerable to adverse effects or better positioned with respect to beneficial effects. In the case of the GDF, the majority of economic benefits including income and employment will be received by lower income groups.

Measures to enhance the distribution of beneficial effects might include training programmes and employment initiatives to target underemployed or hard to reach groups.

Community investment

The UK Government is committed to additional, long-term investment in a host community, to help contribute to the development of its social and economic well-being and in recognition of the essential service it will be providing to the nation. Although the GDF project will create jobs and facilitate economic development, it will also involve economic challenges with regards to tourism, property values and shared services. While direct mitigation measures will be developed to address some of these challenges, additional community investment will allow a host community to take stock of its own needs and strategies for development and provide resources to help meet its development goals.

There is a range of UK and international examples which demonstrate the success of such funding mechanisms in supporting a community not only during the initial stages of a project but into the long-term future, ensuring the welfare of future generations.

The overall costs and benefits associated with the socio-economic effects summarised above remain uncertain, as the analyses included in this report are merely indicative and depend on a variety of factors. However, on balance the results of this study suggest an overall socio-economic benefit to a host community. The economic development and employment results show significant beneficial effects and there is a great deal of opportunity to minimise the potential adverse effects on tourism and property values through careful planning and outreach. Additional community investment offers a further opportunity for socio-economic improvements, driven by the vision of the local community.

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1 Introduction

1.1 Introduction to the generic Disposal System Safety Case

RWM has been established as the delivery organisation responsible for the implementation of a safe, sustainable and publicly acceptable programme for geological disposal of the UK's higher activity radioactive waste. Information on the approach of the UK Government and devolved administrations of Wales and Northern Ireland[2] to implementing geological disposal, and RWM's role in the process, is included in an overview of the generic Disposal System Safety Case (the Overview) [1].

A geological disposal facility (GDF) will be a highly-engineered facility, located deep underground, where the waste will be isolated within a multi-barrier system of engineered and natural barriers designed to prevent the release of harmful quantities of radioactivity and non-radioactive contaminants to the surface environment. To identify potentially suitable sites where a GDF could be located, the Government is developing a consent-based approach, based on working with interested communities that are willing to participate in the siting process [2]. Development of the siting process is ongoing and no site has yet been identified for a GDF.

In order to progress the programme for geological disposal while potential disposal sites are being sought, RWM has developed illustrative disposal concepts for three types of host rock. These host rocks are typical of those being considered in other countries, and have been chosen because they represent the range that may need to be addressed when developing a GDF in the UK. The host rocks considered are:

- higher strength rock, for example, granite
- lower strength sedimentary rock, for example, clay
- evaporite rock, for example, halite

The inventory for disposal in the GDF is defined in the Government White Paper on implementing geological disposal [2]. The inventory includes the higher activity radioactive wastes and nuclear materials that could, potentially, be declared as wastes in the future. For the purposes of developing disposal concepts, these wastes have been grouped as follows:

- High heat generating wastes (HHGW): that is, spent fuel from existing and future power stations and High Level Waste (HLW) from spent fuel reprocessing. High fissile activity wastes, that is, plutonium (Pu) and highly enriched uranium (HEU), are also included in this group. These have similar disposal requirements, even though they don't generate significant amounts of heat.
- Low heat generating wastes (LHGW): that is, Intermediate Level Waste (ILW) arising from the operation and decommissioning of reactors and other nuclear facilities, together with a small amount of Low Level Waste (LLW) unsuitable for near surface disposal, and stocks of depleted, natural and low-enriched uranium (DNLEU).

RWM has developed six illustrative disposal concepts, comprising separate concepts for HHGW and LHGW for each of the three host rock types. Designs and safety assessments for the GDF are based on these illustrative disposal concepts.

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[2] Hereafter, references to Government mean the UK Government including the devolved administrations of Wales and Northern Ireland. Scottish Government policy is that the long term management of higher activity radioactive waste should be in near-surface facilities and that these should be located as near as possible to the site where the waste is produced.

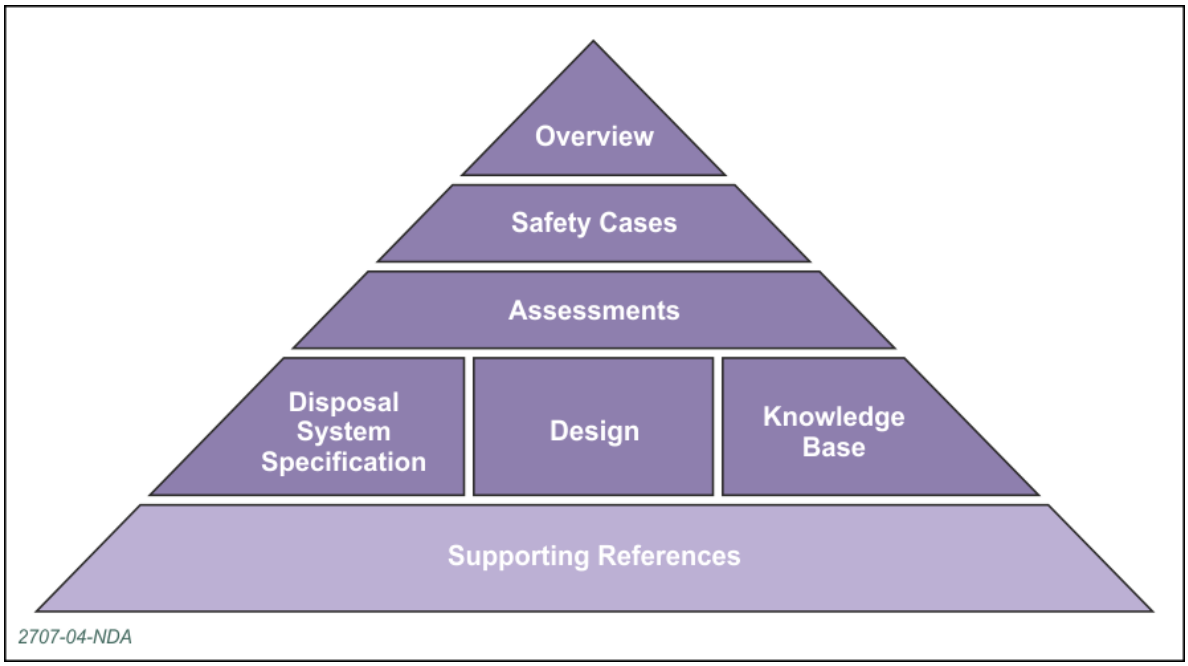
High level information on the inventory for disposal, the illustrative disposal concepts and other aspects of the disposal system is collated in a technical background document (the Technical Background) [3] that supports this generic Disposal System Safety Case.

The generic Disposal System Safety Case (DSSC) plays a key role in the iterative development of a geological disposal system. This iterative development process starts with the identification of the requirements for the disposal system, from which a disposal system specification is developed. Designs, based on the illustrative disposal concepts, are developed to meet these requirements, which are then assessed for safety and environmental impacts. An ongoing programme of research and development informs these activities. Conclusions from the safety and environmental assessments identify where further research is needed, and these advances in understanding feed back into the disposal system specification and facility designs.

The generic DSSC provides a demonstration that geological disposal can be implemented safely. The generic DSSC also forms a benchmark against which RWM provides advice to waste producers on the packaging of wastes for disposal.

Document types that make up the generic DSSC are shown in Figure 1. The Overview provides a point of entry to the suite of DSSC documents and presents an overview of the safety arguments that support geological disposal. The safety cases present the safety arguments for the transportation of radioactive wastes to the GDF, for the operation of the facility, and for long-term safety following facility closure. The assessments support the safety cases and also address non-radiological, health and socio-economic considerations. The disposal system specification, design and knowledge base provide the basis for these assessments. Underpinning these documents is an extensive set of supporting references. A full list of the documents that make up the generic DSSC, together with details of the flow of information between them, is given in the Overview.

Figure 1 Structure of the generic DSSC



1.2 Introduction to the generic Socio-economic Assessment

This report is the generic Socio-economic Assessment (SeA).

The generic DSSC was previously published in 2010. There are now several drivers for updating the safety case as an entire suite of documents, most notably the availability of an updated inventory for disposal [4].

This document, the generic Socio-economic Assessment, is new to the generic DSSC, but updates and replaces the 2014 generic Socio-economic Assessment [5], taking into account changes that have arisen since that time, including changes to the generic design of the GDF, changes to the inventory for disposal and updates in socio-economic assessment good practice.

1.3 Objectives

The generic SeA sets out the likely socio-economic effects of geological disposal, in so far as they can be assessed at a generic level. It updates the previous assessment undertaken in 2014 to take account of:

- recent changes to the inventory for disposal
- RWM's latest generic design work and implementation plans for the disposal system
- Government policy as set out in the 2014 White Paper

The objectives of the assessment are to:

- support the generic design process for the GDF by feeding in potential mitigation and enhancement measures, where appropriate
- support the early stages of the siting process for the GDF
- inform potential host communities of potential socio-economic effects
- support engagement with stakeholders

1.4 Scope

1.4.1 Technical scope

Potential socio-economic effects have been assessed across the following themes:

- employment
- property values and blight
- economic development
- tourism
- population and demographic impacts
- agricultural sales
- social services and infrastructure
- social stability and community cohesion
- housing and accommodation requirements

The environmental and health effects of geological disposal are covered in separate, parallel assessments and are therefore not duplicated within this report [6] [7]. Where relevant, cross references are made to these reports.

The preparation and packaging of radioactive waste for transport and disposal, at waste producing sites, is not covered, and neither is any activity associated with the UK Government's proposed programme of community investment as part of the site selection process. However, the assessment does review what additional community investment has achieved in other waste management and infrastructure projects.

The level of detail and certainty with which different aspects have been addressed is appropriate to the level of information that is available about those aspects of the project at the current generic stage.

1.4.2 Temporal scope

The generic SeA considers the effects of developing the GDF throughout its life cycle:

- the selection of a site for the GDF, including any intrusive, surface based investigations
- the initial period of construction activity, prior to waste emplacement
- the ongoing period of operation (and concurrent ongoing construction of additional disposal areas)
- all of the activities associated with closure of the GDF

It is noted that transport of radioactive waste will occur during the operational phase.

1.4.3 Geographic scope

The assessment does not focus on any specific area or site and considers generically the implementation of geological disposal within England, Wales or Northern Ireland. Scotland is not included as it is Scottish Government Policy that the long-term management of higher activity waste should be in near-surface facilities located as near to the site where the waste is produced as possible. However, where relevant, the assessment has considered the potential for transboundary effects.

During the siting process, the potential effects identified in this report will be explored in greater depth and in the context of known local conditions. Such location-specific assessments will be incorporated into formal Environmental Impact Assessments (EIAs) where appropriate.

1.5 Document structure

The remaining sections of this report are structured as follows:

- Section 2: Methodology – explains the overall approach and methods used to assess the potential socio-economic effects of implementing geological disposal.
- Sections 3–10: summarise potential beneficial and adverse socio-economic effects that may arise throughout the life cycle of the GDF, under each of the themes identified in the technical scope.
- Section 11: Distribution of Effects – considers how the effects identified might be experienced by different social groups.
- Section 12: What Can Additional Community Investment Achieve? can– presents a number of project case studies illustrating the socio-economic (and other) benefits that can be achieved through additional community investment.
- Section 13: Aggregate Socio-economic Effects – considers the conclusions of Sections 3–12 with respect to the overall socio-economic effect on a host community.
- Section 14: Next Steps.
- Glossary: Every effort has been made to write this report in the most accessible language possible. However, the subject matter is unavoidably technical and it has not been possible to avoid the use of some technical terms. To assist in

understanding these, a glossary of technical terms and abbreviations is provided at the end of the main text, before the appendices.

- Appendices: several appendices are included, presenting a more detailed analysis of potential socio-economic effects for several of the themes covered in the main body of the report. The appendices cover the key socio-economic impact categories, including employment impacts, economic development impacts, tourism, population and demographic impacts, community benefits packages and agricultural impacts.

2 Methodology

2.1 Approach to assessment of effects

This section outlines the overall approach to the generic socio-economic assessment work. More detail on the approaches and methods used to assess potential effects under each theme can be found in the following sections and their associated appendices.

Socio-economic assessment is a multidisciplinary process that considers a wide range of potential effects on individuals and communities. It is also designed to identify evidence based measures to mitigate adverse effects and to make the most of opportunities for socio-economic benefits.

The approach features both quantitative and qualitative assessment. For Chapters 3, 4 and 6, for example, the socio-economic impacts are quantified using accepted economic impact methodologies (in the case of employment impacts, for example, this covers direct, indirect and induced employment as well as the use of standard economic multipliers). The contents of these chapters contain the headline findings and impacts whilst the corresponding technical appendices cover each area in more detail.

For the remaining chapters, the approach is based on qualitative analysis, research and the review of case studies. For several of these topics, more detailed information is provided in supporting appendices. For example, additional information regarding community benefits packages and examples from around the world are contained in Appendix E.

As far as possible, effects have been considered for each phase of the life cycle of the GDF (siting process, construction, operation, closure). For this generic assessment, detailed information covering typical 'peaks' and 'troughs' of impacts during these different phases is not available. This level of information will be available at the detailed EIA stage. Peak impacts may, for example, be higher than the reported averages provided in this generic assessment.

Socio-economic effects have been considered at the national, regional and local / district[3] level (defined here by county council, district or borough data) in England, Wales and Northern Ireland, with any internal spill-over effects at a national level also accounted for. Regional effects have been described according to groups of regions with similar characteristics to represent the range of effects that could occur.

Impacts such as those on landscape character and visual amenity, access to recreational open space, noise impacts, light pollution, congestion and social impacts / impacts of population inflows to a rural community are addressed in other generic assessment documents: the generic Environmental Assessment Report and the Health Impact Assessment Report [6] [7].

2.2 Mitigation of socio-economic effects – general principles

Socio-economic effects have generally been considered in the absence of any detailed proposals for mitigation, monitoring or enhancement, as these are frequently location-specific. However, opportunities for mitigation, monitoring and enhancement measures have been identified and are highlighted in text boxes at the start of each of the following chapters. Such opportunities will be considered further during the site selection process. In addition, Chapter 12 reviews the opportunities afforded by additional community investment and presents a number of case studies from both the UK and overseas where

[3] A district is an administrative sub-division of the UK, governed by a local authority.

targeted investment has provided significant community benefits. Further details are provided in Appendix E.

Certain principles will be applicable throughout the life cycle of the GDF. These principles are based on the 'mitigation hierarchy':

- **Avoidance**

  Where there is potential for a significant negative effect, the first option is always to avoid the effect, through selection of an alternative location, alternative technology or other changes to the development.

- **Minimisation**

  Where avoidance is not possible, action is required to reduce and/or minimise potential negative effects, through changes in design and/or other actions during construction, operation or closure. Any negative effect that remains after minimisation efforts are taken into account is sometimes referred to as a 'residual effect'.

- **Compensation**

  Where neither avoidance nor minimisation efforts have completely removed a negative effect, or reduced it to an acceptable level, then works are generally required to compensate for the unavoidable residual effect as appropriate. Examples of compensation measures could include replacement of a community facility at another location, for instance by creation of a new facility to replace one that would be lost.

- **Enhancement**

  It is important that developments consider the opportunity to provide an overall net gain, through the identification and implementation of 'enhancement' measures. This is in line with national planning guidelines which include, as a core planning principle, a commitment to planning that improves and enhances the places where people live.

2.3 Taking uncertainty into account in the assessment

This assessment deals with the potential socio-economic effects of the GDF at a 'generic' level, that is, with no more precise assumption about its location than that it will be somewhere in England, Wales or Northern Ireland. This inevitably introduces a significant degree of uncertainty into the assessment.

Such sources of uncertainty are recognised and taken into account in the level of detail to which potential effects under each socio-economic theme have been assessed, the extent to which each aspect of the development has been considered in the assessment, and the level of confidence attached to the assessment findings.

Key aspects of uncertainty are outlined below:

- **Geological environment**

  The geology of the UK is varied and complex. To facilitate RWM's generic design work, three generic rock types have been defined that broadly encompass all the many different geological environments in which the GDF can be located ('higher strength rock', 'lower strength sedimentary rock' or 'evaporite rock').

- **GDF design**

  Generic design options exist for the GDF, but no such design can ever be considered definitive for the purposes of assessment until it has been applied and adapted to a specific location to develop a site-specific design, by taking into

account factors such as geological environment, local topography, drainage and access requirements.

- **Social and economic characteristics of the host community**

  These are clearly unknown at present, but will be fundamental to location-specific assessments during the siting process.

To help address the level of uncertainty inherent in a generic assessment, for some themes a range of plausible scenarios has been explored using assumptions about typical regional and district characteristics. Where quantitative estimates are not possible, given the generic level of the study, qualitative conclusions and relevant case studies have been provided to give an indication of the range of outcomes that can be expected.

The degree of uncertainty will reduce throughout the siting and future assessment processes. However, any remaining areas of uncertainty will be reported at each stage, including within any formal EIA.

3 Employment

The NDA Manpower and Skills 2012 report [8] and addendum present estimates of the direct employment required at each stage of the GDF – people directly employed in the siting, construction, operation and closure of the facility. Based on these sources, it is estimated that the GDF will support 500-600 new FTE jobs in an average year throughout the lifetime of the facility. These include both on-site and off-site jobs – with off-site jobs primarily comprising office-based work that is assumed to be undertaken at an RWM office or similar location outside the host district.

With the implementation of initiatives to support development of the local skill base (see Box 1 below), many of these direct jobs could be filled at a local level.

Box 1. Employment focused on the local community

Example measures, such as those listed below, could help to ensure the local community makes the most of the employment opportunities presented by the GDF:

- subject to the availability of a labour pool, maximise the number of direct jobs based 'on-site' (locally)
- develop and implement a Workforce Development Strategy that will set out how the project will maximise employment and skills opportunities for local people while also fostering young peoples' interest in careers in the science and technology sectors
- appoint a specialist team, including local community partners to carry out the Workforce Development Strategy
- develop and implement a training and skills programme to impart best practice providing skills training for local people for construction and operational jobs
- encourage contractors to provide apprenticeship and employment opportunities to local people
- partner with a local training provider and national skills body to establish a construction apprenticeship learning hub
- establish a local job readiness programme and encourage the construction supply chain to continue to invest in workers
- establish a local employment brokerage that will publicise job vacancies and put in place initiatives to ensure employment opportunities for hard to reach groups
- implement a Science, Technology, Engineering and Mathematics Programme in local schools, focusing on encouraging community members that may otherwise be discriminated against

The types of jobs that will be provided fall into ten job categories: commissioning, safety and security, radiation protection, project management, engineering design, scientific and technical support, business, construction (internal estates), estate and GDF operations and decommissioning operations.

These categories of jobs are distributed across five skill levels:

- skill level 1 – semi-skilled
- skill level 2 – skilled

- skill level 3 – technician
- skill level 4 – management/professional
- skill level 5 – senior management

The majority of jobs supported will be concentrated at skill levels 2 and 3. In terms of qualifications, skill level 2 equates to GCSE (Grades A to C) and/or NVQ Level 2; skill level 3 equates to A Levels and/or NVQ Level 3. These skill levels will include jobs in safety, security, project management and construction.

There are three different types of employment impacts as set out below.

- **Direct employment**

  Jobs generated directly at the GDF (covering direct jobs generated during the difference phases of the GDF). Examples include the direct on-site construction employment generated as well as direct on-site employment during the operational phase.

- **Indirect employment**

  Jobs generated in the supply chain, that is, those sectors and industries that provide supplies and services to the GDF during the different phases of the project. Examples might include businesses providing construction materials and plant, catering services, infrastructure maintenance and so on.

- **Induced employment**

  Jobs generated and supported by the spending of direct and indirect employees. For example, by spending a proportion of their disposable income in the local area, the GDF construction workforce will help support additional employment.

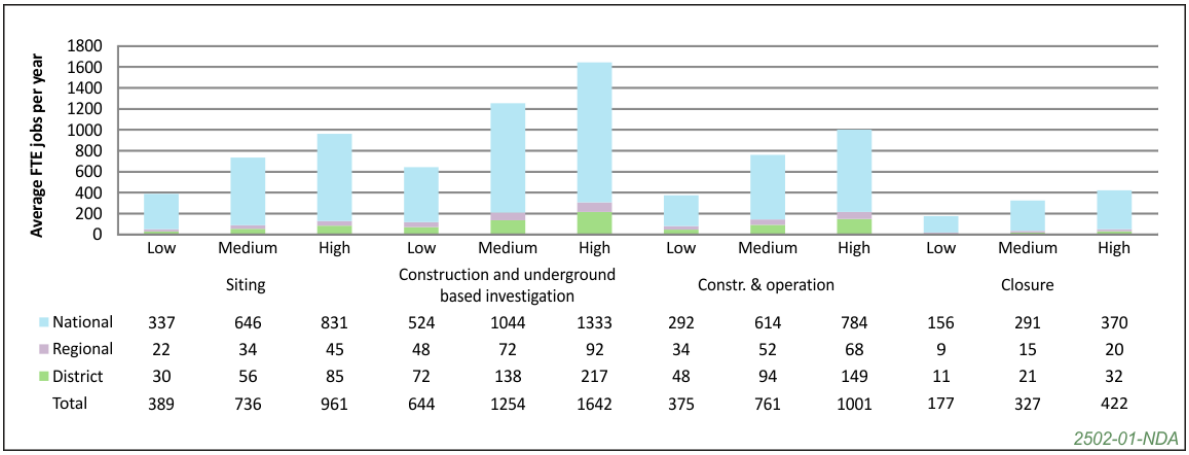
The total employment effect associated with the GDF is therefore the sum of all direct, indirect and induced jobs created.

Based on economic impact guidance (see Appendix A), factors known as multipliers have been applied to the estimated number of direct jobs created by the GDF to estimate both the indirect and induced employment effects. There are separate multipliers for indirect and induced employment impacts, for example.

Although there are no standard multipliers specific to the radioactive waste disposal industry available at present; a range of values was generated from the Additionality Guide [9] as well as multipliers from the UK mining and construction sectors. Comparisons were also made with multipliers derived from studies of other geological disposal projects in Canada, the US and Switzerland. Taking into account different approaches to implementation, the nature of the inventory for disposal and the size and design of the facility, the indirect and induced employment projections from these international studies were found to be broadly similar. The multipliers assumed are relatively conservative and may not fully reflect the potential mitigation and enhancement measures that could be employed (as listed in Box 1).

It is estimated that in addition to the 500-600 direct jobs created, 400-1,000 jobs could be created through indirect and induced employment effects. Figure 2 shows the average annual additional (indirect and induced) jobs that might be created in each of the four GDF phases as well as the likely distribution of these additional jobs in terms of geography (national, regional or within a host district).

Figure 2 Indirect and induced employment average annual effects at national, regional and district levels[4]



	Siting			Construction and underground based investigation			Constr. & operation			Closure		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
National	337	646	831	524	1044	1333	292	614	784	156	291	370
Regional	22	34	45	48	72	92	34	52	68	9	15	20
District	30	56	85	72	138	217	48	94	149	11	21	32
Total	389	736	961	644	1254	1642	375	761	1001	177	327	422

Overall, it is estimated that up to 1,600 new FTE jobs (including direct, indirect, and induced employment) could be supported as an annual average over the lifetime of the GDF (not to be confused with the 1,600 plus peak indirect and induced jobs shown above in Figure 2 during the construction and underground based investigation phases).

Figure 2 indicates that most jobs are not local to the GDF. However, with the implementation of initiatives to support development of the local skill base (see Box 1), between 500 and 700 of these jobs (covering indirect and induced employment) could be available at a local (district) level. Most of these would be secure, long-term, skilled jobs in safety, security, project management and construction. Given the ongoing policy objective of boosting employment and productivity levels in the UK, this would represent a significant socio-economic gain for most local communities.

If geological disposal is not implemented, the baseline assumption is that ongoing surface storage of the wastes would be required at various locations throughout the UK. It is difficult to predict what this baseline scenario would mean in terms of employment. However, over a similar timeframe to the construction and operation of the GDF, the ongoing maintenance and management of storage facilities (rather than their progressive closure and decommissioning as waste is transferred to the GDF) is unlikely to involve a significant number of jobs. The 'net' employment effect of implementing geological disposal as opposed to ongoing surface storage is therefore likely to be only slightly less than the figures quoted above.

Further detail on the range of different employment scenarios that have been considered can be found in Appendix A. More detailed analysis will be undertaken at a community and site-specific level during the siting process, to refine the assumptions made and increase the level of certainty in employment projections.

4 Low = Low multipliers, and low local absorption, Medium = Medium multipliers and medium local absorption, High = High multipliers and high local absorption (see Appendix A for further details).

4 Property Values and Blight

The potential effect of the GDF on property values and blight is recognised as a key concern for potential host communities. In this context, blight refers to 'planning blight' where property values may be adversely affected by proposals for new development – such as the GDF. For some developments the effect on property prices may be felt during the siting process, before planning and regulatory consents are obtained and construction commences. Potential mitigation and enhancement measures to address potential effects on property values are outlined in Box 2.

Box 2. Example Mitigation and Enhancement Measures for Property Values

Mitigation and enhancement measures for the GDF could include:

- preparing and implementing a Property Value Protection (PVP) Plan to be applied during the siting process and beyond to compensate for losses associated with any decreases in property values, rental income or associated mortgages
- as part of the PVP Plan development process, taking into consideration the timing, geographical / spatial extent of the GDF and the compensation options available
- developing a Public Outreach Strategy that addresses safety or risk concerns from the local and broader population.

RWM recently commissioned a review to examine whether the GDF is likely to affect property values and to consider the possible merits of a PVP plan to protect owners against a potential loss in value resulting from proximity to the GDF or from the GDF siting process [10].

The three key objectives of this work were:

- to identify and assess the evidence (from the UK and overseas) relating to the impact or perceived impact of the process of selecting sites, developing and operating the GDF on property values in the area around such a facility
- to identify and analyse the salient characteristics of PVP schemes (in the UK and overseas) which have been implemented to mitigate the effects of large infrastructure projects (including radioactive waste facilities)
- to bring the above information together to enable RWM to make informed decisions concerning potential development of a PVP scheme for geological disposal in the UK

4.1 Property values

Property values are a product of many factors including social, economic, physical/ environmental factors and Government influences. They also tend to fluctuate over time and can change dramatically over the long and/or short-term.

The review indicates that both the site selection process and the subsequent announcement of a chosen GDF location are likely to result in a *perception* that property values will be at risk. Demands for some form of reassurance are therefore likely from the very beginning of the process.

In contrast, the evidence suggests that once the GDF is in operation, it is likely (though not certain) that concerns will abate and there will be a positive effect on property values, driven by an influx of skilled workers and an increased demand for local housing.

The review also concluded that any effects on property values are likely to be very localised and restricted to an area within a few kilometres of the GDF or proposed site. Effects in the wider community or at a regional level are very unlikely. The scale and extent of any negative effect is also likely to be less in relatively remote and sparsely populated areas, whereas the probability of positive effects is likely to increase in areas with limited employment opportunities.

4.2 Property value protection

PVP schemes provide property owners with protection against a potential loss of value in their properties arising from the project or development proposed. These schemes go beyond the statutory protection of Blight Notices under the Town and Country Planning Act (where the property must be required for the development) or Part 1 (where a physical impact is required). Thus the impact on value under a PVP scheme does not have to be related to any specific factor other than the presence of the project. The implication is that potential buyers (or renters) of property may have a reduced willingness to pay for property in the vicinity of the project. This may relate to unspecified risks or perceived stigmatisation.

It is entirely rational for property owners to be risk averse concerning the value of what is in most cases their major asset. PVP schemes are intended to demonstrate that the developer/operator of a facility or the implementer of a siting process understands these concerns and is, in effect, *insuring* the property owners against the risk to their property values. It is not generally the intention that beneficiaries of schemes should be made better off than was the case before the project was started. PVP schemes are thus not an inducement to accept a facility but a form of insurance.

More detailed socio-economic assessment work at a community and site-specific level will be undertaken during the siting process to better understand possible effects on property values. The development and implementation of a PVP scheme will be considered further as part of this work.

5 Economic Development

5.1 Introduction

Economic development in the context of this report refers to the quantitative and qualitative changes in an economy associated with the introduction of the GDF. The additional expenditure associated with implementing geological disposal has been estimated for the possible construction of the GDF in any of the three host rock types considered in RWM's generic design work:

- higher strength rock (HSR)
- lower strength sedimentary rock (LSSR)
- evaporite rock (EVR)

The assessed effect on economic development is different in each case, largely reflecting differences in the cost of constructing underground facilities in different host rocks. The effects have been assessed at three different levels: district, regional and national.

5.2 Additional expenditure by spatial level

The additional expenditure likely to be generated in the economy (expressed as undiscounted spend over the lifetime of the project)[5] is shown in Table 1.

Table 1 Additional expenditure (undiscounted, average across host rock types)[6]

District (£ billion)	Regional (£ billion)	National (£ billion)
3.4 – 8.3	2.4 – 5.4	7.8 – 37.9

With the implementation of mitigation and enhancement measures to support development of the local supply chain, such as those outlined in Box 3, the benefits at a district level will more likely be towards the higher end of the range indicated.

As well as rock type, the costs of developing the GDF will depend on a number of other factors, including the length of the operational period which, in turn, reflects the size of the inventory for disposal. As the developer, RWM updates on an annual basis the estimated costs of the GDF project. These figures are made publicly available in the NDA Annual Report and Accounts.

5.3 Direct spend by geology type and stage of project

Based on current assumptions and for the purposes of this economic analysis, the total costs of implementing geological disposal (based on a range of costs across the different host rock types) are presented in Table 2. Direct cost assumptions have been adjusted to

5 'Undiscounted' means that the expenditure is presented in terms of 'today's' money (that is, in terms of 2016 money values) with no adjustment for the timing of when the expenditure occurs.

6 Regional effects are those with district effects subtracted. At the national level, the regional and district effects are subtracted.

reflect the proportion of imports from outside the UK, which are assumed to constitute around 23% of total project costs[7].

An example of the mitigation measures that could be put in place to enhance economic development set out shown in Box 3.

Box 3. Example Mitigation and Enhancement Measures for Economic Development

Example measures such as those listed would help to ensure that the local community could make the most of economic development opportunities presented by the project. These measures also need to be considered alongside the enhancements suggested under the employment section.

- prepare and employ a local business engagement strategy
- review local businesses that have relevant or matching skills to participate in the project and construct a database independently maintained by the local chamber of commerce
- appoint a local Supply Chain Officer
- appoint a Procurement Officer
- establish and publish performance data for businesses based on an agreed set of performance indicators
- facilitate a network to link contractors and major suppliers with smaller local companies
- develop and implement a joint strategy with local authorities for marketing to new businesses
- develop and implement a business support scheme to help businesses develop their business skills and management competencies
- develop and implement a Local Enterprise Growth Initiative to increase local entrepreneurial activities and support the growth of locally-owned businesses in deprived areas
- develop and implement an economic transition scheme for transition between project phases and after closure of the site.

[7] This assumes that the total project spending will be distributed as follows: 75% on goods and 25% on services and employment. Of the goods procured, 30% are expected to be imported.

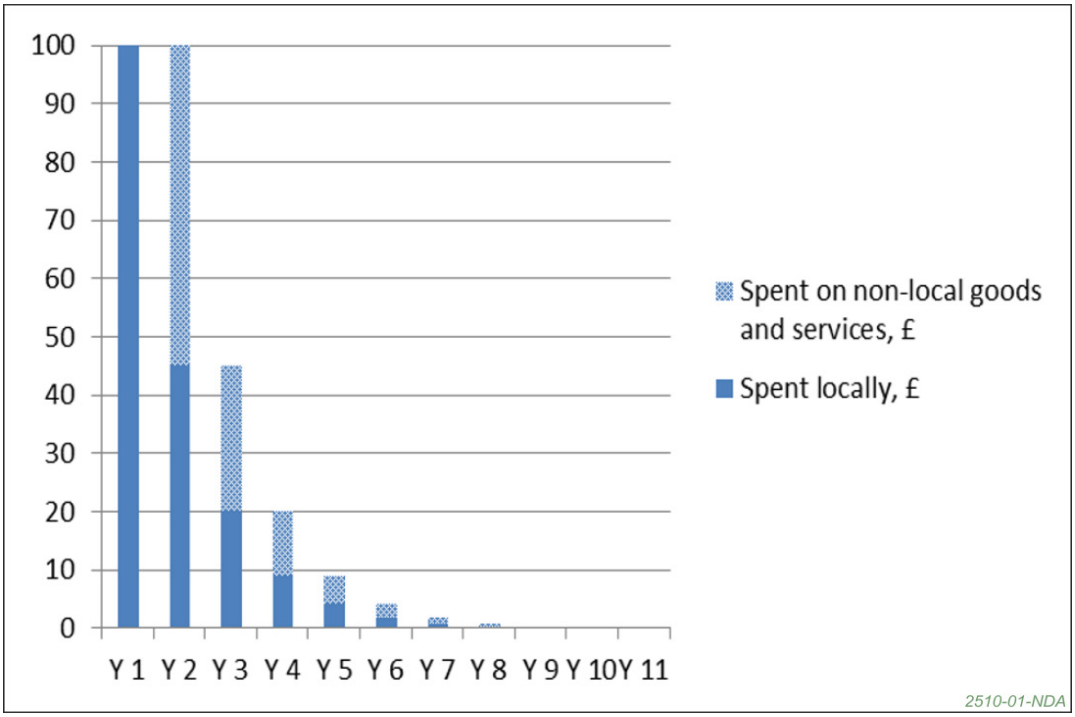
Table 2 Estimated direct spending[8] [11]

Project Phase	Assumed spend per phase – based on range across different geologies (£ million)
Siting process	1,400
Initial construction to first waste emplacement	2,500 – 3,000
Ongoing construction and operation	15,300 – 24,200
Closure	900 – 1,000
Total	20,100 – 29,600

5.4 Multiplier effects

As with employment, direct spending is expected to have wider knock-on effects in the economy known as indirect and induced effects (collectively termed 'multiplier effects'). When new income is introduced into an economy it leads to extra spending which, in turn, generates further income. Some of the additional income will be spent locally and some will be spent on imported goods. Different types of projects result in different multiplier effects due to factors such as 'economic linkage' - the degree to which the economy can provide the goods and services a project needs. Figure 3 illustrates the multiplier effect. It shows that for every £100 spend locally; a percentage will create further spending both locally and in the wider region the following year.

Figure 3 Illustration of Multiplier Effects[9]



8 These are indicative, undiscounted figures based on RWM's latest generic design work [11].

9 This figure illustrates the effect of spending in Year 1 only; whereas direct expenditure for the GDF would continue throughout the project duration.

Robust multipliers specific to the nuclear waste disposal industry do not yet exist. However, studies on other geological disposal projects in countries such as Canada and Switzerland suggest that multipliers from the construction and mining sectors are good equivalents. These were therefore adopted for this study. Details of the multipliers used at a district, regional and national level can be found in Appendix B.

To generate a plausible range of economic development effects, high, medium and low multipliers were developed based on the estimated level of economic linkage between direct spending and indirect/induced spending. The indirect and induced effects were then estimated at the district, regional and national levels as presented in Figure 4 and Figure 5. For illustrative purposes, these are based on a composite of costs across the HSR, LSSR and EVR host rock types.

Note, the 'expected value' point (featured as a green square) is considered to approximate to the most likely value and the blue lines provide the estimated upper and lower bounds of the estimate.

Figure 4 Average annual (undiscounted) spend

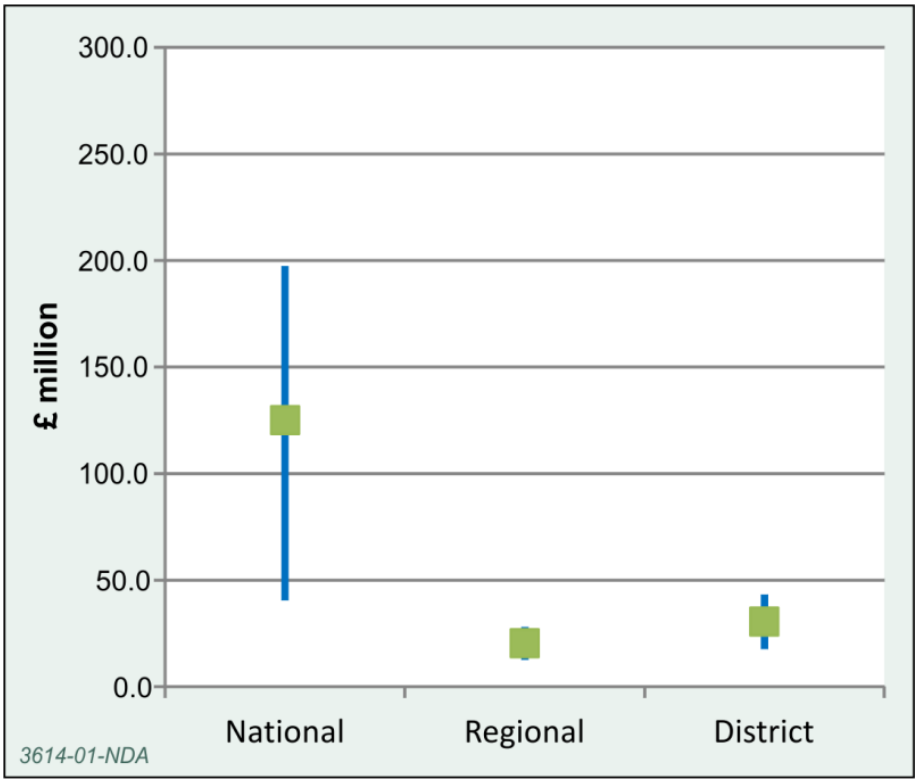
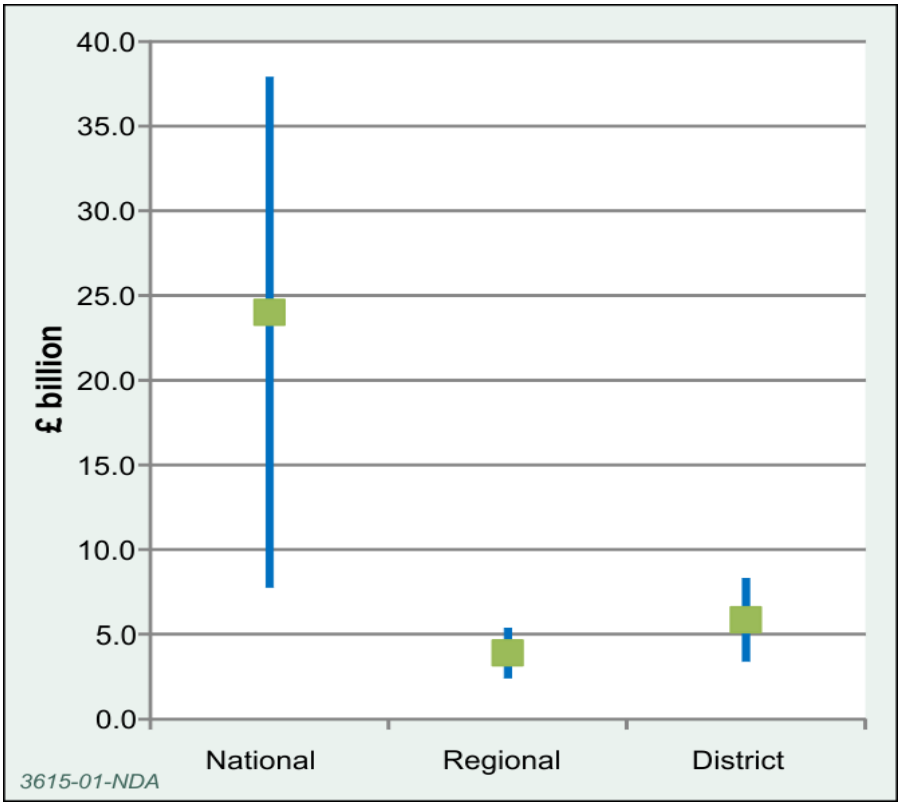


Figure 5 Undiscounted spend over the lifetime of the project



5.5 Total undiscounted economic effect

The total undiscounted benefit to the economy as a result of the GDF is estimated to range from around £13.6 billion to £51.6 billion, as shown in Table 3. As with Figures 4 and 5, these estimates are based on a composite of HSR, LSSR and EVR costs to provide a broad indication of potential effects.

Table 3 Total undiscounted economic effect (£ million)

Location	Lower	Likely UK median	Higher
District	3,418	4,268	8,300
Regional	2,441	5,497	5,371
National	7,785	24.020	37,886
Total	13,644	33,785	51,557

5.6 Impacts at different geographical levels

At a district level it is difficult to forecast to what extent a local economy may be able to support development of the GDF. For many communities, supply chain linkages may be minimal and economic benefits would therefore tend to be towards the lower end of the range indicated. For others (for example, those with a more developed industrial base), the benefits could be towards the higher end of the range. In any case, if some or all of the example measures outlined in Box 3 are implemented, it might be expected that the total economic development effects of the GDF would be closer to the higher end of the range. This total does not include consideration of the additional community investment that would

be available to a host community, which could generate further indirect and induced spending.

The objective of this analysis is to provide a broad understanding of the potential economic development effects which may result from the development of the GDF. However, given that it is a generic level analysis rather than a geographically specific one, the results are considered to be uncertain. Once a site for the GDF is selected, site-specific analysis will be undertaken to refine the assumptions applied and decrease the level of uncertainty expected in the results.

Further detail on the approach to defining the range of economic development scenarios can be found in Appendix B.

5.7 Possible displacement effects

The focus of this chapter has been the impact of expenditure on the GDF at different stages during the facility's lifecycle and the impacts at different spatial levels. Multiplier effects have also been taken into account. Although there are several positive impacts associated with such a significant financial investment, the GDF could displace expenditure on other projects in other parts of the country. However, consideration of such effects is outwith the scope of this analysis.

6 Tourism

6.1 Introduction

Tourism is a major industry in the UK accounting for around 9% of GDP in 2014. The potential effect of the GDF on tourism is recognised as a key concern for potential host communities and is an issue that has been raised by stakeholders in the UK, as well as overseas for similar geological disposal projects. This section considers potential effects on overnight stays and travel spending for work-related trips (business tourism) and tourism for leisure purposes (leisure tourism). The assessment focusses on effects on a host community (district-level effects).

Analysis of other similar projects indicates that the GDF is likely to have a positive effect on business tourism. The tourism analysis suggests that at a local (district) level, the total spend from business tourism associated with the construction and operation of the GDF will be between £6.7 million and £13.3 million (undiscounted over the lifetime of the project).

In terms of leisure tourism, it is more difficult to predict likely effects. Based on assumptions from international studies on related projects, the potential effects to the UK leisure tourism industry from the GDF could range from a total loss of £398 million in a rural coastal area to a total loss of up to £1,681 million in an urban coastal area (undiscounted over the lifetime of the project). Inland rural and urban areas were also analysed and results are presented below, but these figures represent the upper and lower range of the findings. However, much will depend on the characteristics of the existing tourist industry at a particular location and the measures taken to attract visitors to the area.

To make the most of the opportunities for business tourism and to minimise potential adverse effects on leisure tourism, mitigation and enhancement measures such as those outlined in Box 4 could be considered.

6.2 Scenarios considered

Two scenarios were assessed to predict potential effects of the GDF on leisure tourism over four typical geographical classifications: urban inland, rural inland, urban coastal and rural coastal. Scenario I is based on the approach outlined in a Swiss case study [12] that estimates the effects based on an annual loss in tourism revenue throughout the construction and operation phases of a geological repository project. Scenario II takes a worst case scenario approach based on two US case studies and assumes that effects will be five times higher during a 'critical period' of up to ten years following initial construction. After this period, if no accidents occur, it is assumed that tourism losses will return to the levels in Scenario I.

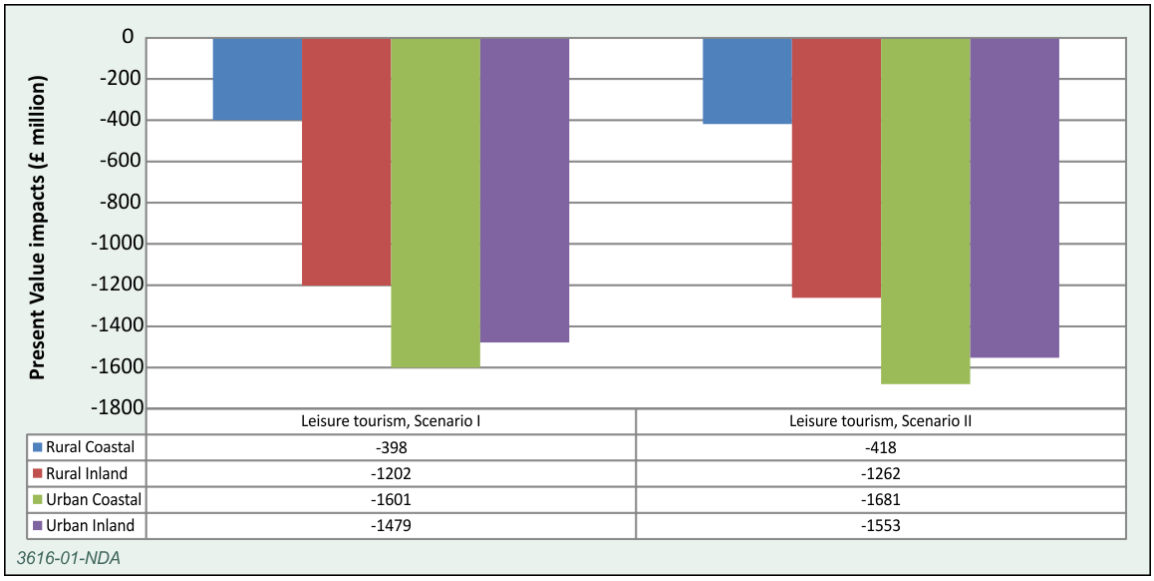
The outcomes for both scenarios are presented in Figure 6. Under Scenario I, effects on leisure tourism vary from a loss of £1,601 million in urban coastal areas, to a loss of £398 million in rural coastal areas throughout the lifetime of the project. Under Scenario II, incorporating an initial critical period, effects vary from a loss of £1,681 million in urban coastal areas, to a loss of £418 million in rural coastal areas throughout the lifetime of the project.

Box 4. Example Enhancement and Mitigation Measures for Tourism

Example enhancement and mitigation measures could include:

- develop and implement a public outreach and awareness raising programme as part of the GDF siting phase including a media strategy and local outreach materials
- develop and implement an educational programme in local schools to promote understanding and awareness about the functions of the facility including school trips to the GDF
- develop a visitors centre and support facilities to promote awareness of the facility and its function
- instigate a payment for disruption of services programme for businesses that experience disruption as a result of GDF development (for example national park areas)
- develop and implement a business support scheme and a Local Enterprise Growth Initiative with a component specifically focused on the tourism industry to increase local entrepreneurial activities and support the growth of locally-owned tourism businesses
- develop a Communication Centre on-site that could be used for local community initiatives and become a meeting place for the local population
- designate investment for local art programmes and unique landscaping features to attract interest in the facility.

Figure 6 Total undiscounted costs to leisure tourism



	Leisure tourism, Scenario I	Leisure tourism, Scenario II
Rural Coastal	-398	-418
Rural Inland	-1202	-1262
Urban Coastal	-1601	-1681
Urban Inland	-1479	-1553

6.3 Impact of visitors' centre

It is anticipated that there will be a visitors' centre at the GDF and that this would open significantly in advance of the main facility becoming operational. This will enable various educational programmes to be put in place to help inform the local community (and other stakeholders) of the various characteristics and benefits of the GDF. The introduction of a visitor centre at the site will generate tourism benefits (in the form of visitor spending) that will partially offset any adverse effects on leisure tourism. As noted in the case studies in

Appendix C, this is a common occurrence at other waste disposal facilities where 'open days' and special events (as is the practice at the Andra site in France) attract large numbers of visitors.

Visitors can be expected to peak in the summer months, depending on the location of the GDF, for example if it is near an existing tourist destination. It is also expected that educational trips for pupils and students will form a relatively high proportion of the visitors, and that these are likely to be less seasonal, with a tendency to be away from the summer period.

Based on similar sites, it is estimated that a visitor centre could attract between 11,000 and 100,000 visitors per year, with the upper range incorporating a large number of school trips and therefore generating limited spend per visitor. Assuming each visitor spends £5-£10 per visit, an additional £55,000 - £1,000,000 in tourism revenue could be generated per year (see Appendix C for detail). These figures will have to be weighed against the costs of building and running the centre, which have not been included in this assessment. In an average year over the course of the project, tourism benefits (associated with a visitor centre) have an undiscounted present value for the project lifetime of £7.3 to £145 million.

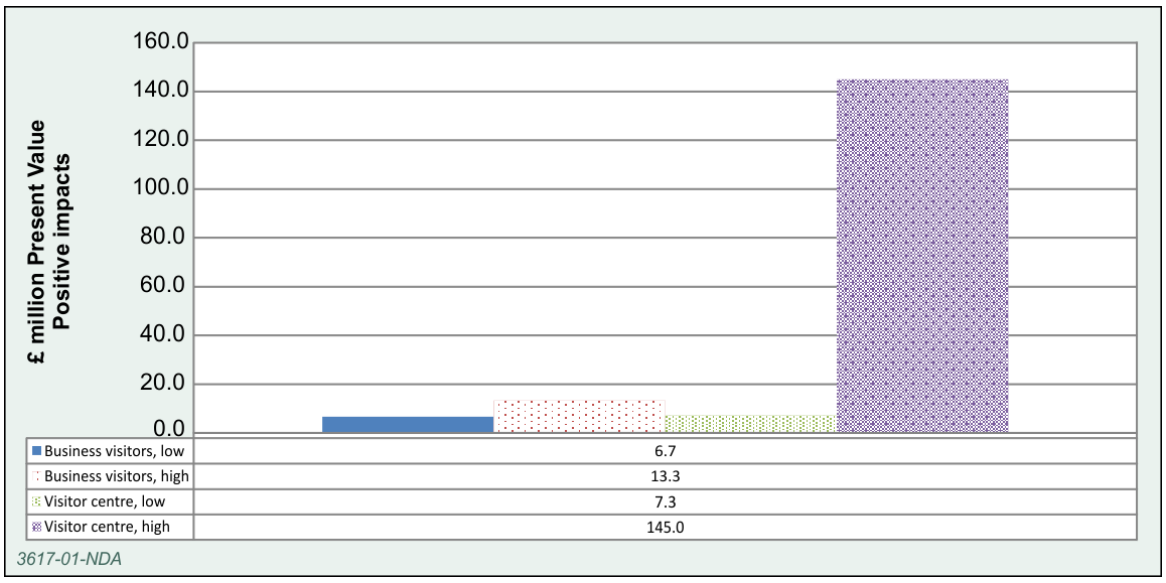
6.4 Impact of business tourism

Additional business tourism generated by the GDF will also partially offset any adverse effect on leisure tourism. In order to estimate this effect, the analysis assumes 20-40% of off-site employees will be required to travel to the site once per month (see Section 3 and Appendix A for further detail on employment estimates) and that each visit generates £110 additional expenditure per night for accommodation and other expenses. In an average year over the course of the project, business tourism benefits are thought to range from £0.04 to £0.08 million, with an undiscounted present value for the project lifetime of £6.7 to £13.3 million.

The number of visitors expected whilst the site is operational is considered in the Transport System Designs Report [13]. This envisages that the number of car journeys from visitor activity will be between approximately 10 and 80 per day. Although the majority of these business visits will not entail an overnight stay, there will still be additional benefits (visitor spending on accommodation and subsistence) from those that do stay overnight.

Figure 7 shows the projected added tourism spending associated with a visitor centre and additional business travel.

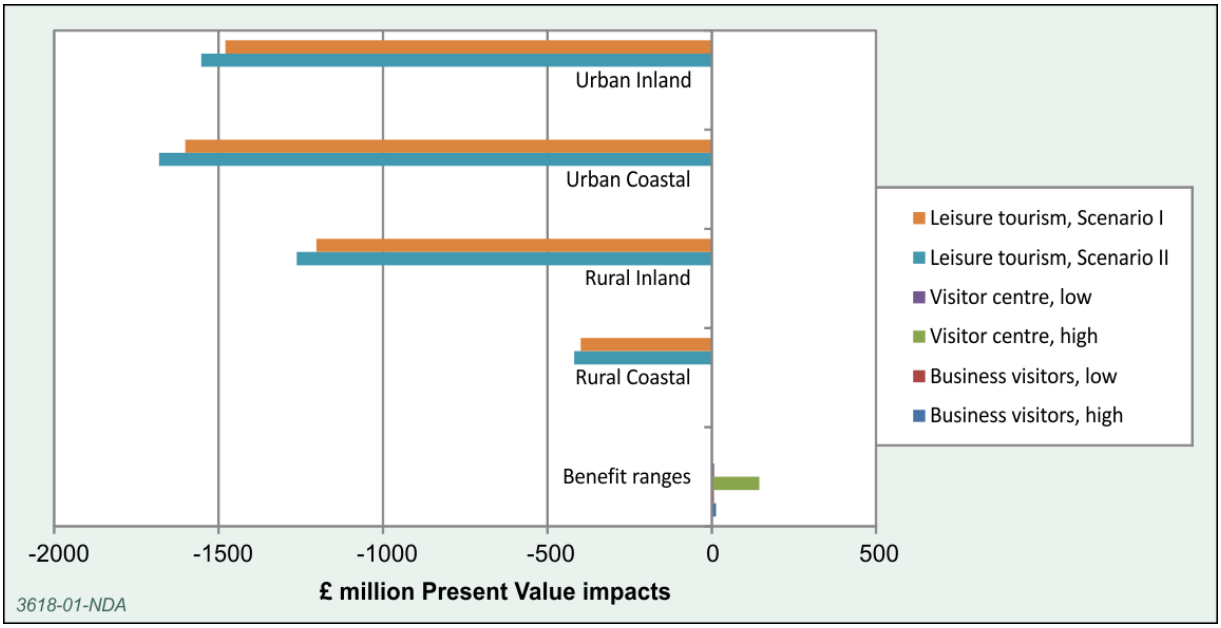
Figure 7 Total undiscounted benefits to tourism



The total results for all scenarios are presented in Figure 8. These combine the effects on leisure tourism with potential additional tourism spend generated by a visitor centre and business travel. The results (in undiscounted terms) suggest that the net effects to the tourism industry could range from around -£1,681 million for an urban coastal area in Scenario II, to -£398 million in a rural coastal area in Scenario I. On balance, negative effects wil probably be higher for urban areas and highest for urban coastal areas.

These results only relate to the GDF itself. They do not include consideration of any wider effects that the transport of radioactive waste might have on tourist numbers and spending. A separate Transport Logistics Report, described previously, considers generic transport movements associated with the GDF.

Figure 8 Total undiscounted tourism losses and benefits



Further detail on the approach to defining the range of economic development scenarios can be found in Appendix C.

It is likely that, over time, adverse effects will diminish as the facility becomes a more accepted feature of the area, particularly if there have been no significant accidents or newsworthy operational incidents. The overall effects will be dependent on the nature of the existing tourism industry. Where existing levels of tourism are low, there may be overall tourism benefits associated with the GDF as a result of increased business tourism. However, where existing levels of leisure tourism are relatively high, there may be adverse effects on leisure tourism, which will need to be weighed against any positive effects on business tourism. The possible adverse effects on leisure tourism could be mitigated through raising the profile of the host community as a tourist destination as suggested in Box 4. This could also be supplemented by tourism and visitor enhancement programmes supported by additional community investment.

7 Agricultural Sales

7.1 Background

In 2013, the total income from farming in the UK was £5.6 billion generated from approximately 222,000 commercial agricultural holdings employing a total of 464,000 within the agricultural workforce. UK-wide land uses vary, with arable and horticultural crops, uncropped arable land, common rough grazing, temporary and permanent grassland and land used for outdoor pigs. This does not include woodland and other non-agricultural land (roadways, buildings and yards). The latest available Office for National Statistics (ONS) statistics (2013) for the UK show that agriculture represents 65% of the total UK land area. Further work undertaken by ONS in 2014 indicates that this proportion has not changed [14].

At a broad level, farm types in the UK consist generally of grazing livestock (dairy, beef and sheep) to the west, whilst the east of the UK is more arable and pig oriented. The arable sector also includes the more intensive horticultural cropping that has an inherently higher value of output per hectare. From this very simplistic categorisation it can be seen that the potential impact on agriculture of the GDF will vary depending on where it is located. For example, there may be a lower economic impact at a district/regional/national level within a more upland area, where the agriculture is less intensive than a highly intensive lowland area that produces a greater proportion of high value branded agricultural products. However, effects on an individual farm holding or particular specialist type of farming may be greater in an upland area than in an area where intensive lowland farming is widespread.

Effects may be experienced based upon the perceived risk of the GDF in terms of potential contamination of the agricultural land and therefore the agricultural produce from that land.

This could be influenced by a number of factors:

- intensification level of agricultural enterprise/land use
- level of regional branding
- level of traceability of the commodity
- level of local sales/marketing

To illustrate the potential scale of effects in terms of perception, the effect on a small horticultural business selling most of its produce through its farm shop would be greater than that of an arable farmer selling wheat into a large central grain cooperative.

7.2 Case studies

To investigate these potential effects, a review of relevant UK and European studies on similar sites has been undertaken, with key findings presented below.

For HPC, the Environmental Statement concentrated on potential employment, economic, population and demographic effects. The assessment concluded that the facility will have negligible socio-economic effects in terms of direct economic impact and disruption impacts on agriculture [15].

Within the Hinkley Point C Economic Strategy [16] there were two main concerns expressed on the potential impacts on agriculture:

- Hinkley Point C might adversely affect perceptions of the county's food produce
- the local labour market may not be able to meet the needs of the agricultural sector

The study concluded that because perceptions are inherently hard to measure, it is difficult to gauge what the effects of Hinkley Point C will be on agricultural business. Comparisons were also made with the tourism survey, which suggested the effects are unlikely to be significant.

A Swiss energy study carried out to assess the economic impact of a deep geological repository on the various regions of Switzerland did go some way to putting a monetary value on the economic impact [12]. The study assessed the proportion of agricultural produce that was regionally branded or direct marketed. For the region with the lowest proportion of agricultural land and a small proportion of products originating in the region, the calculated decline in agricultural Gross Value Added (GVA) during the construction and operation activities was estimated to be 0.1 million Swiss francs each year (around £80k). For the region with the highest share of viticulture (wine-making) in a major agricultural region, the calculated decline in value added in agriculture was 0.6 million Swiss francs each year (around £480k).

The report also quoted some research work carried out in connection with the proposed Niederamt nuclear power station. A group of farmers were surveyed and 67% indicated that the nearby Gösgen power station had no effects on their sales of agricultural produce, with only two out of 55 stating any negative effects as a result of 'fear' from their customers.

In a similar way, during the siting process for the long-term storage facility for radioactive wastes in the Netherlands, local farmers expressed concerns about possible stigma effects on their produce and the implementing body, COVRA, agreed to mitigate any demonstrable impacts. The site, near Vlissingen, has been operational since 1992 and to date there have been no claims for compensation or mitigation.

Several studies were undertaken on the effects on branding in Cumbria and the Lake district when communities in west Cumbria were considering participation in the siting process for the GDF. According to the baseline economics research conducted by DC Research [17] and research conducted by Sedley Place [18], branding effects are largely tied to the geography of the area. The strength and influence of a brand is based on perceived associations such as the rural nature or the peace and tranquillity of the area. However, this research also notes that studies conducted in Sweden, Finland and Canada involving the placement of nuclear facilities within a community, have shown that there is little tangible evidence, either negative or positive, of the effects on agricultural businesses with the addition of nuclear facilities.

Any effects on sales will be related to a perceived change in characteristics of the area, such as loss of purity or a change in quality. Research conducted on branding effects in Cumbria and the Lake District suggests that pre-emptive planning and quick and decisive communication strategies may be important in helping to ensure brand protection and in minimising the potential for any adverse effects on agricultural sales.

In addition, the conclusions from the work undertaken by Rütter and Partners in 2005 [19] are informative and indicated the following.

- For the interim storage facility in Würenlingen, Switzerland, the majority of companies surveyed (66%) stated that the facility had no impact on sales (in particular, sales of wine had not been adversely affected).
- For the storage facility at the Centre at l'Aube, France, a similar picture emerges with all those interviewed as part of the survey work indicating that there will be no adverse effects on agriculture.
- For the interim storage facility (forming part of the then Gorleben repository project) in Germany, there was no direct evidence that agricultural sales have been adversely affected by the storage facility. Nevertheless, 42% of the regional

population surveyed stated that they believed sales of agricultural products had been adversely affected due to the 'image' of the facility.

- For the HLW repository project in Olkiluoto, Finland, there were no negative effects on the sale of agricultural products. Based on two telephone interviews with farmers, for example, no adverse effects had been observed.

Other key themes that emerged from this work were that, if an incident occurred at a facility that lead to contamination, this would adversely affect the marketing of agricultural products. Also, from a marketing perspective, it was found that sales of certain types of agricultural produce (organic food, for example) were not affected if there was no linkage made between the place of manufacture and a nearby nuclear waste facility.

In the case of the proposed Gorleben repository, for those products where the point of manufacture is not given (such as alcoholic drinks based on potato extract, milk and meat products), consumers have not made a connection between these products and the nearby repository.

It should be pointed out that Germany has since introduced a new repository siting process and it is uncertain whether Gorleben will continue to be a candidate site.

7.3 Conclusions

As the studies conducted in the UK for Hinkley Point C (as well as several studies of nuclear facilities in Switzerland, Sweden, Finland and Canada) have shown, there is little tangible evidence that such facilities have either negative or positive effects on nearby agricultural businesses (Further detail of the assessment of potential effects on agriculture can be found in Appendix F).

Notwithstanding these findings, consideration will be given to the measures outlined in Box 5 to help ensure brand protection and to minimise the potential for adverse effects on agricultural sales.

Box 5. Example Enhancement and Mitigation Measures for Agricultural Sales

Example enhancement and mitigation measures could include:

- develop and implement a public outreach and awareness raising programme as part of the GDF siting phase including a media strategy and local outreach materials that addresses perceived risks concerning agricultural produce
- implement a brand protection strategy and subsequent promotional campaigns

8 Social Services and Infrastructure

8.1 Introduction

This section considers socio-economic effects in relation to services and infrastructure. It should be read alongside the Generic Health Impact Assessment [6], which considers effects in relation to health, including effects on health services.

Social and public services are designed to serve families and individuals in the community, address health and emergency service needs and provide support in maintaining personal well-being. During the life cycle of the GDF, demand on local community services is likely to increase. The extent of this will depend on the phase and on the measures taken to address such needs. For example, it is anticipated that the operational workforce may be more likely to move permanently to the community within which the GDF is sited, while some construction phase workers may seek more temporary accommodation (depending on the nature and duration of their work). Internalising the requirement for some facilities for GDF personnel may reduce or avoid adverse effects on existing infrastructure. Provision of new facilities or enhancement of existing facilities may result in benefits in terms of social services and infrastructure.

8.2 Mitigation and enhancement measures

The mitigation and enhancement measures outlined in Box 6 could be implemented to prevent any adverse effects on, or to provide improvements to, public services. In addition, depending on community priorities, these measures could be supplemented by health, education or public service programmes supported by additional community investment.

Box 6. Example Enhancement and Mitigation Measures for Social Services and Infrastructure

- Prepare a Police and Fire Resourcing Strategy in consultation with local service providers which will cover risk assessment, emergency planning, incident response and resource analysis.
- Pay a contribution to the local service providers towards the cost of employing any additional police officers or fire personnel considered necessary during the construction and operational periods.
- Provide health and welfare facilities for workers to be housed close to site.
- Make a contribution towards any increased capacity considered necessary for local hospitals and GP services throughout project operations.
- Provide a range of leisure, sports and recreation facilities for the workers to be housed close to site.
- Monitor the effect of the GDF on pupil numbers in local schools and make appropriate contributions towards employing additional educational staff if capacity is exceeded.
- Develop an emergency response plan including orientation and training, to familiarise emergency service staff with the new facility. This will include the regular emergency exercises carried out by licensed nuclear sites in the UK.
- Implement a program of preventative health measures for GDF workers.

8.3 Health, emergency and public services in the UK – a summary

The GDF and the expected change in associated population within a host district is likely to place some additional demands on hospital beds, emergency services, policing, fire-fighting, school enrolment and other community and recreational resources.

The UK National Health Service includes:

- National Health Service (NHS) (England)
- Health and Social Care in Northern Ireland
- NHS (Wales)

These three systems (together with NHS (Scotland)) are largely independent; however, the term NHS is used as a catchall to refer to any of these publicly funded health care systems. They provide a comprehensive range of health services, the vast majority of which are free at the point of use, for all legal residents in the UK. According to the World Bank, in the UK in 2011 there were approximately 3 hospital beds per 1,000 people [20]. OECD data for 2012 provide similar statistics (2.8 beds per 1,000 people) [21].

Emergency services are also provided by the NHS. Emergency medical responses are provided through local ambulance services, each covering a large geographical area. There are ten services in England; one for Northern Ireland and one for Wales (divided into three regions). Response times vary, but average approximately 10 minutes.

There are 43 police forces in England and Wales. Between 30 September 2014 and 30 September 2015 there were reductions across all worker types in the police forces in England and Wales. There were 125,185 police officers in September 2015, a decrease of 1.5% since 30 September 2014 [22].

At present, there are 53 fire brigades in England, Wales, Scotland and Northern Ireland. According to the Department for Communities and Local Government, Fire and Rescue Operational Statistics Bulletin for England 2014-15, there were 44,000 full time equivalent fire-fighters in England as at 31 March 2015 [23].

Between 2011 and 2015 the school pupil to teacher ratios in nursery schools in England has increased (from 16.2 to 17.6). The ratio in local authority maintained primary and secondary schools were 20.3 and 14.9 respectively (compared to 20.5 and 15 in November 2011) [24]. At the same time, the number of teaching assistants and school support staff has increased.

8.4 Population trends in the UK

According to the ONS, the total population of the UK (excluding Scotland) as of mid-2014 was over 64 million. Over the year to mid-2014 the number of people resident in the UK increased by 491,100 (up 0.77%), which is above the average annual increase (0.75%) seen over the last decade [25]. The UK population is projected to increase by 9.6 million over the next 25 years from an estimated 63.7 million in mid-2012 to 73.3 million in mid-2037 [26]. The UK population is projected to increase by approximately 7.3% by 2021 and approximately 20% by 2041.

8.5 Impact of manpower requirement

The total direct manpower requirement for all project activities associated with the GDF is equivalent to an average annual employment of between 500 and 600 (see Section 3). As a worst case scenario, if all these jobs were taken up by people outside a host district, therefore requiring people to move into the area, this would represent a population increase of 0.3% in the smallest district and 0.04% in the largest district. This slight increase in demand is expected to continue over a substantial period of time (100 years or more),

although the actual number of personnel will vary by phase and is anticipated to peak during the initial construction phase. The ratio of population to services is generally lower in rural areas.

For comparison, the socio-economics study completed for Hinkley Point C estimated that the project will result in an increased demand of 3-4% on local schools [27, p. 74][10]. A 2011 study for Ontario Power Generation in Canada on the proposed deep geologic repository used economic modelling to project the increased demand for services in a community with a population of 70,000. Results suggested an annual increased demand of around: one in-patient hospital bed; one staff person for both emergency medical and police services; and two firefighters [28].

Any increase in capacity required could be addressed by the mitigation measures outlined in Box 6. These measures could also be supplemented by health, education or public service programmes funded by additional community investment. Further consideration of effects on services in relation to health is provided in the Generic Health Impact Assessment report [6].

[10] However, it is worth noting that if you increase a population by 1%, it is likely that the 1% will be of working age and are more likely to have children of school age than the general population. So 3-4% extra in schools may result from 1% population increase; therefore assessment once localities have been identified in terms of local demographics will provide more clarification on this point.

9 Social Stability and Community Cohesion

9.1 Introduction

Community cohesion refers to people's sense of belonging to a community and whether or not the community is considered a social asset. This section considers social and economic aspects of community cohesion. It should be read alongside the Generic Health Impact Assessment [6], which considers effects on community cohesion in relation to physical, mental and social health.

According to the Centre for Social Relations at Coventry University, community cohesion can be described most simply as the state of a community when there is:

- trust and common understanding between individuals, communities and wider society
- participation in civil society and being active citizens
- a society at ease with itself, with a real sense of security, welcome and belonging
- respect for the rule of law and the values that underpin society
- possession of civil, political and social rights and responsibilities [29]

9.2 Community cohesion

The concept of community cohesion has also been associated with happiness, life satisfaction and social capital, all of which form part of the social quality of life and contribute to social cohesion. There is a potential risk associated with changes in levels of satisfaction with community life, including people's feelings of personal health and sense of personal safety. However, given the long-term nature of the project it is possible that, over time, the GDF will contribute positively to community cohesion. It will, for example, provide long-term, stable employment for hundreds of people and help to develop a distinctive sense of place. Some studies have suggested that 'nuclear communities' can develop a strong sense of social cohesion and community pride [30].

Any potential adverse effects on community cohesion and well-being could be addressed by mitigation measures such as the development of a public outreach strategy to address health and safety concerns and a community integration plan to help GDF employees relocating to the facility to integrate with the local community (see Box 7). Indeed, some overseas GDF development programmes include the re-location of the waste management organisation's headquarters to the siting community, as seen, for example, in Finland and South Korea.

In a cohesive community, a network of positive relationships is generated and maintained, and there is a level of community pride. Several factors can be used as an indication of community cohesion, including length of residency in a community and the intactness of the demographic characteristics of the households. Key factors contributing to residents' feelings of community cohesion stem from changes to community assets and public attitudes towards the community, including a sense of personal safety or a change in their satisfaction with community life.

On a regional basis, population mobility is relatively low. By examining inter-regional migration patterns and respective regional inflow and outflow data, it can be deduced that approximately 98% of the regional population are non-movers and 2% are movers. London has the highest percentage of UK movers, over 3%. The north-east and the north-west have the lowest percentage of regional movers (1.7%).

Box 7. Example Enhancement and Mitigation Measures for Community Cohesion

- An effective programme of community engagement will allow local people to interact, share views and influence how their community develops over time with the GDF in place. This could incorporate a Public Outreach Strategy that addresses safety concerns from the local and broader population.
- Encourage community to articulate and promote their needs and aspirations, which could include new facilities, with provision for local people to access these facilities.
- Develop and implement measures to assist in the integration of employees into the local community, such as an employee code of conduct (with guidance on behaviour offsite and outside of working times) and a community integration plan (for employees relocating to integrate with the local community).
- Establish a committee of community and GDF representatives (for example through a Community Liaison Group) to continue to build on the willingness to participate and liaise with local community leaders about opportunities for community development.

For the purposes of this socio-economic assessment, no public surveys to measure changes in people's attitudes related to the GDF have been conducted. However, research conducted for Ontario Power Generation's Deep Geologic Repository project has shown that individuals who experience an adverse change in their feelings of personal health, sense of personal safety or a change in their satisfaction with community life may choose to voluntarily leave their communities. The work also suggested that individuals or groups tend to conduct a mental 'cost-benefit' analysis of what they are satisfied or dissatisfied with in their communities and there is a tendency to tolerate certain conditions until a threshold is reached. At such a time, individuals or groups may become more motivated to leave and find a new location with more positive and satisfying features [30].

Social science theorists have proposed that this threshold that motivates action or changes in behaviour is due to their images of places becoming 'marked' or stigmatised by positive and negative attitudes [31]. This research also indicates that several things must happen before a strong association develops and socio-economic effects begin to emerge. First, stigma requires a precipitating event or trigger to bring about behavioural changes. In the case of a fixed facility, the facility itself would have to become a salient issue. People (whether local residents, people living outside a community, tourists or other visitors) would have to have a very high level of awareness of the facility and feel threatened by it to the extent that they would seek out and accept 'information' about a facility from their neighbours, family and friends, Government, the media and the facility operator. Second, the information they hear or otherwise receive about the facility would have to confirm their beliefs and attitudes that the facility threatens them personally or their community as a whole. Thirdly, before any noticeable socio-economic effect occurs, people would have to have a high enough level of concern to change their behaviours in response to their attitudes and beliefs [32].

There can be a marked difference between community reactions to potential changes in well-being and quality of life, depending on the location. Clearly, as work for the nuclear waste management organisation in Canada on development of community selection criteria has shown [33], if a proposed facility is located away from existing nuclear host communities, with little or no industry familiarity, the potential impacts due to changes in the existing social structure can be significant.

9.3 Case studies

Many social studies have probed the relationship between the local population and an established nuclear facility. Studies have consistently indicated that individuals living very close to the nuclear facility associate lower levels of risk with the facility than those living further away [30]. People who live near to or who are familiar with a nuclear site perceive greater benefits and fewer risks [34]. Indeed, research has demonstrated how people adapt to geographic proximity to nuclear facilities, developing a suite of coping mechanisms to offset perceived risks. It appears that familiarity with a nuclear facility gained through an individual's social networks connects them to the facility, which can act to demystify the facility as distant and threatening (which can also function to increase trust) [35].

According to public attitude research conducted by Ontario Power Generation for the proposed deep geologic repository in Canada, 9% of local study area residents and 10% of regional study area residents reported that they might experience reduced feelings of personal health and the sense of safety as a result of the project. Up to 3% of people in the study area believed that their satisfaction with community life will decrease 'a great deal' as a result of the project and were considered to be the most likely to fundamentally change their attitudes such that they might actually consider moving from their community (they demonstrate the strongest behaviour intention to move) [30].

Given the relatively low levels of UK population mobility [36], the generally long lengths of residency, it is projected that only a small percentage of the local population might consider moving as a result of their community hosting the GDF. The value of 3% quoted for the deep geologic repository project in Canada is comparable to the typical percentage of 'movers' that could be expected at a regional level in the UK from the GDF, in a given year. Considering that people do not always act on their intentions, actual out-migration of existing residents because of the GDF seems likely to be minimal. This would be further offset through an effective communication and public outreach strategy. In addition, it is noted that the White Paper includes a commitment to a community 'test of support'. It is anticipated that this would occur once sufficient information is available but prior to an application for development consent for the GDF. If the community's response is negative, the White Paper states that development of the GDF could not progress. This approach will therefore contribute towards community cohesion in relation to the GDF and help to reduce the likelihood of residents moving as a result of implementation of the GDF.

Given the long duration of the project, any initial effects are likely to decrease over time as the facility becomes a more established feature of life in the area. For communities that already have nuclear facilities present, the likelihood of effects on community cohesion will probably be even lower due to the desensitisation that has already occurred. In the event that some individuals do leave, they are likely to be replaced by other job seekers or those who may be more tolerant of local conditions.

Any change in community cohesion could be addressed by the example mitigation measures outlined in Box 7.

10 Housing and Accommodation Requirements

Each of the phases throughout the life cycle of the GDF will involve an influx of temporary and/or permanent workers to the host community.

The highest employment is expected during the initial construction of the facility, prior to first waste emplacement when it is estimated that there will be over 1,000 people working on the project during peak times, with about 800 based 'on-site'. Given the generic nature of this assessment, it is not possible to estimate how many of the workers will require additional housing and accommodation and how many might be housed within existing stock. More detailed assessments at a community and site-specific level will be undertaken during the siting process.

Potential mitigation and enhancement measures for housing and accommodation effects are outlined in Box 8.

Box 8. Example Enhancement and Mitigation Measures for Housing and Accommodation

- Prepare an accommodation strategy to meet the accommodation requirements of the GDF and mitigate the potential impacts on local housing supply and demand.
- Liaise with local housing authorities to ensure that local housing stock is utilised prior to constructing new facilities.
- Monitor the uptake of accommodation facilities bi-annually and submit a report and update of the accommodation strategy to the relevant authorities.
- Consider whether near-site accommodation for workers is required that is affordable and easy to book.
- Consider a monetary donation to local authorities to increase the housing supply in the area if required.
- Establish an accommodation office to provide advice on where to find accommodation in the local area.

As an indication of possible housing and accommodation effects, the housing and accommodation strategy for the proposed construction and operation of Hinkley Point C nuclear power plant has been reviewed [37]. For Hinkley Point C it is anticipated that of a total of 5,600 workers (at the peak of construction), 3,700 workers will require housing and accommodation in the local area. The kinds of accommodation sought by the construction workforce will depend on the nature of their role on the project and the length of time for which they are employed. Table 4 details the number of workers expected to live in a variety of accommodation types.

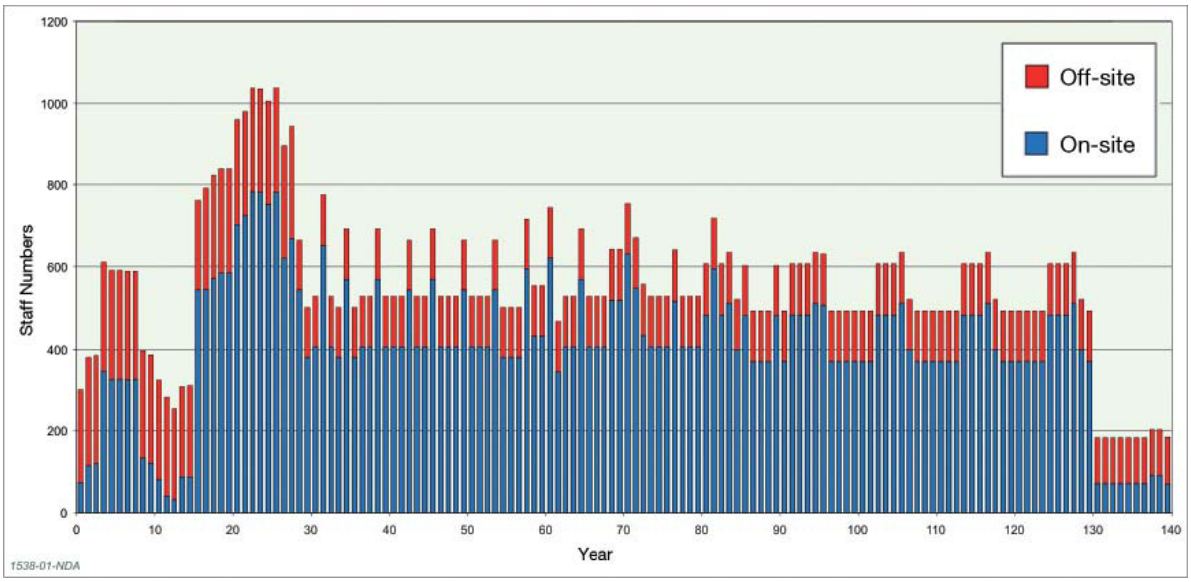
Table 4 Accommodation of Hinkley Point C workers

Accommodation Type	No. of Workers	%
Campus	1450	39
Owner Occupied	500	14
Tourist	600	16
Private Rented Sector	750	20
Latent Accommodation	400	11

Although the workforce for the HPC project will be much larger than that required for the GDF, these figures provide an indication of the range of accommodation types that might be required.

According to the manpower and skills analysis for the GDF [8], the average annual employment during the project lifetime will be in the order of 500 to 600 direct FTE jobs (although average employment will vary significantly throughout the programme). A breakdown of anticipated manpower requirements over time taken from the Manpower and Skills Report is shown in Figure 9. This assumes an operational period of around 100 years, although the currently assumed inventory for disposal will entail an operational period of some 150 years.

Figure 9 Total manpower requirements over time



More detailed assessments at a community and site-specific level will be undertaken during the siting process. These will be able to assess levels of local housing and accommodation stock and any consequent requirements to increase supply.

It is likely that any change in housing demand could be addressed by the example mitigation measures described in Box 7. These measures could also be supplemented by accommodation programmes funded by additional community investment.

11 Distribution of Effects

Major infrastructure projects do not affect all segments of society in a uniform way. Certain groups can be more vulnerable to adverse effects or better positioned to benefit from beneficial effects. In general, those most economically deprived in society are the most vulnerable and least able to cope with adverse socio-economic effects, but may also benefit most from positive interventions.

As described in the employment analysis (see Section 3), direct job creation will be highest (46%) at skill level 2, which in terms of qualifications equates to GCSE (Grades A to C) and/or NVQ Level 2. This will include jobs in safety, security, project management and construction, which are most likely to be absorbed at a district or regional level. Table 5 below shows the average earnings for each skill level and the relative value of a salary to earners in each income category.

Table 5 UK full-time average pay at selected percentiles

Skill Level	1 – Semi-skilled	2 - Skilled	3 – Technician	4 – Management / professional	5 – Senior management
Percentile	20th	40th	60th	80th	90th
UK Full-time Average Pay	£17,448	£23,123	£30,188	£40,815	£52,684

To help ensure an equitable distribution of effects, the potential mitigation and enhancement measures outlined in Box 9 could be considered.

Box 9. Example Enhancement and Mitigation Measures for Distribution of Socio-economic Effects

- Conduct an Equality Impact Assessment for the GDF and identify an Action Plan to mitigate disproportionate and differential impacts on protected groups.
- Establish a local employment brokerage that will publicise job vacancies and put in place initiatives to ensure employment opportunities for all groups, including those harder to reach through traditional employment initiatives.
- Establish a job training programme and apprenticeship opportunities.
- Implement a Science, Technology, Engineering and Mathematics Programme in local schools with content to encourage disadvantaged groups and those harder to reach through usual education initiatives.

The approach to assessing distributional effects applied in this assessment considers the relative financial weight of income experienced by different economic groups. In other words, a pound of additional income is worth more to somebody who is relatively economically deprived than to somebody who is relatively wealthy. The implication of this is that, all other things being equal, the distribution of positive effects will have greater benefit to society overall if they are assigned with greater weight towards relatively deprived areas or groups. In the case of the GDF, the beneficial effects from additional income to currently unemployed or underemployed people will result in relatively greater benefits than for those higher up the pay scale.

Adjustment factors from the UK Green Book [12] were applied to the results of the employment analysis to determine how the income will generally be received. These factors are as follows:

- bottom quintile: 2.2
- 2nd quintile: 1.45
- 3rd quintile: 1.05
- 4th quintile: 0.75
- top quintile: 0.45

The highest skilled jobs are assigned a lower 'weighted' economic value with the lower skilled jobs corresponding to a higher 'weight.'

The results are presented in Table 6 below, illustrating the total range of potential annual economic benefits from supported employment once distributional weights are applied to the different earning groups. The range of potential effects has been applied to both the high and low range estimates of employment creation (see Appendix A).

The results show that the majority of annual income will be received by lower income groups. This is based on the assumption that lower income groups are associated with lower skilled jobs. Thus, the economic benefits of the GDF are likely to affect a larger proportion of lower income groups at a district and regional level, followed by skill level 3 workers, which is synonymous with median level income.

Table 6 District and region weighted distributional effects (per annum)

Skill Level	1 – Semi-skilled	2 - Skilled	3 - Technician	4 – Management / professional	5 – Senior management
District	£292,634 – £402,268	£5,396,898 - £8,555,563	£372,652 – £1,371,627	£0 - £571,363	£0 - £63,624
Rest of Region	£18,133 – £72,949	£2,039,547 - £3,363,788	£1,070,639 – £1,313,314	£1,288,722 – £1,640,192	£120,886 – £152,698

Other distributional effects, considering issues such as age, disability, gender reassignment, pregnancy and maternity, religion, sex, sexual orientation, and intergenerational equity will be assessed during the siting process as outlined in RWM's proposed approach to Equality Impact Assessment [38].

12 What Can Additional Community Investment Achieve?

12.1 Overview

International examples demonstrate that an important safeguard generally offered to potential host communities for radioactive waste management is that the community should not find itself worse off than before the process began [39]. The GDF project will include mitigation measures specifically designed to ensure this and, as set out in the 2014 White Paper [2] the UK Government is committed to providing community investment to further the social and economic well-being of that community.

The White Paper states, for example, that investment might include improved local education and skills investment, improved transport infrastructure and improved recreational facilities. Use of the investment will be tailored to specific localities, and managed locally so as to bring long-term benefits focused on ensuring a positive economic and social legacy arising from the development.

The investment will therefore be additional to the investment and jobs that the GDF will bring to an area. It is also additional to any agreements between the developer and communities to mitigate impacts during construction.

The investment made available will be significant and will be comparable to other international GDF projects. In addition, the investment will generate intergenerational benefits specific to the community hosting the GDF.

The UK Government will make initial investment available early on in the siting process to support the development of communities that engage with the site selection process. Community investment of up to £1 million per year will be made available in the early stages of the siting process. This will rise to £2.5 million per year for communities that progress to the stage of borehole investigations and will continue for as long as they are engaged in the process [2].

The investment must be spent in accordance with best practice in delivering value for money and must deliver measurable local environmental, social and / or economic benefit. The investment will be retained by the community even if development of the GDF did not proceed in the area.

Following on from the White Paper, a working group was convened by DECC (now BEIS) to provide advice on community representation – the Community Representation Working Group (CRWG). The group also considered issues such as the disbursement of additional community investment as well as the mechanisms by which funding should be routed to a community and who should administer the funds. The findings of the CRWG are being used to develop the Government's policy on working with communities.

The concept of additional community investment goes a step beyond the measures employed to offset any potential socio-economic effects directly associated with the GDF, to help ensure that a host community experiences a net socio-economic benefit. This section presents evidence and examples from other projects and offers insight into what additional community investment might achieve – particularly when integrated with the mitigation and enhancement measures developed as part of project implementation.

According to the COWAM (COmmunity WAste Management) December 2009 Research Brief on Community Benefit and Support Packages, *"There is increasing evidence that benefit packages are being designed as integrated development instruments intended to not only support a community during the initial stages and through facility operation, but also into the long-term future, with special reference to the welfare of future generations"* [42].

Internationally, a range of agreement mechanisms has been used to facilitate the provision of social and economic benefits to a community hosting a major development. Such mechanisms provide a way for communities to access funding for socio-economic development and to secure an ongoing involvement in managing the socio-economic effects of project implementation. They are wholly compatible with a consent-based site selection process and collaborative working, setting out a vision for a joint future and, in most cases, legally binding the project promoter/implementing organisation and the host community to delivering their contribution to it.

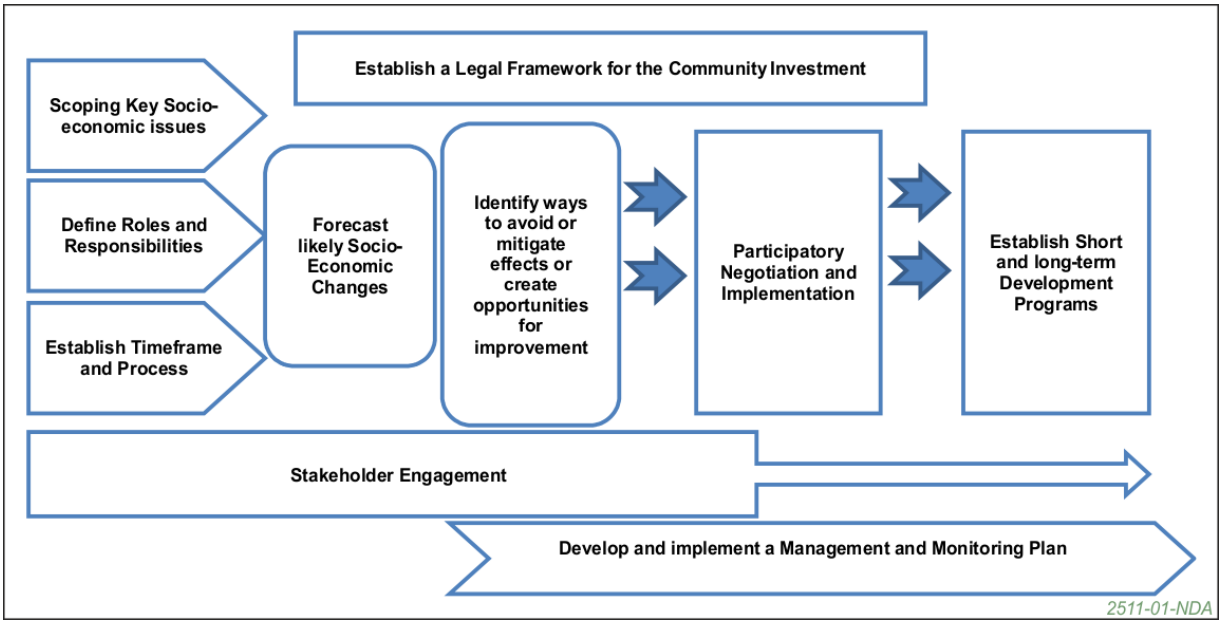
The process generally includes a Government allocation of money for the host community, followed by community negotiation regarding the use of the investment, with a final recommendation of programmes to be carried out followed by funding of an investment programme.

The organisation and management of additional community investment associated with the GDF has not yet been defined, but could incorporate the following:

- creating participatory processes and deliberative spaces for community discussions about desired futures - the acceptability of likely effects and potential benefits
- gaining a good understanding (socio-economic profiling) of the communities - including stakeholder analysis to understand different needs, interests and aspirations (sometimes referred to as ‘visioning’)
- scoping the key socio-economic issues
- collecting relevant baseline data
- forecasting likely socio-economic changes that might result from project implementation (including consideration of alternatives)
- establishing the significance of such changes
- identifying ways to avoid, minimise or compensate for negative effects and to take advantage of opportunities for improvement
- facilitating an agreement making process between the project proponent and affected communities which leads to the drafting of a community based agreement (CBA) that incorporates project based mitigation measures and improvements, as well as additional community benefits
- developing a management and monitoring plan (MMP) that puts into operation all the benefits, mitigation measures, monitoring and governance arrangements agreed to in the CBA as well as plans for regular review and for dealing with unanticipated issues as they arise

This process is illustrated in Figure 10.

Figure 10 Example of a community investment development process



12.2 Relevant case studies

Based on a review of current literature, there are various international examples of traditional and non-traditional applications of community investment for large scale infrastructure projects. Benefits can include:

- job skill and training programmes
- affordable housing
- infrastructure
- recreational facilities
- institutional facilities
- environmental remediation
- investment for community programmes

Effective agreements have mechanisms for ensuring equitable contributions and increased public participation in their development and implementation. These mechanisms, as described above, rely upon creating an effective participatory process between the project proponent and affected communities and developing an effective management and monitoring plan to measure progress. This in turn provides project accountability and community acceptance of the project benefits and the trade-offs.

Progressive examples of community investment go beyond mitigating effects and actually improve conditions of the community through social investment. For example, in Australia and Canada local community residents are directly negotiating with mining companies to develop 'participation agreements' or 'impact benefit agreements' that include pragmatic conditions, such as capacity building, supply chain commitments, cultural heritage protection or business opportunities. In the US, community based agreements have been developed to fund an assessment of community park and recreation needs and commit funds toward meeting those needs; fund residential permit parking programmes; and fund capital improvements for libraries and schools, children's health programmes, public housing, and job training programmes. In the UK, public procurement regulations restrict the ability of a community benefits programme to guarantee that a certain proportion of direct spend goes to the local supply chain. However, initiatives can be supported that

enable the local supply chain to compete effectively. Some possible applications of a community investment concept as they could apply to geological disposal are outlined below. Further details of each programme can be found in Appendix E.

'Community visioning' is also being developed. As part of the GDF siting processes in Canada and Switzerland, for example, the Waste Management Organisation has initiated discussions with potential communities (in Canada) or regions (in Switzerland) to address what these communities perceive as being the most likely outcomes with and without a facility.

The intention is to enable the communities to have an appreciation of the likely impact and to assist them in deciding whether or not they want to continue with site investigation and development. In Switzerland, however, this 'local veto' has been removed and there will only be a national vote when final sites have been selected. In Canada, although the communities can postpone their participation until a later point in the process, this is dependent on the nuclear waste management organisation concluding that the area looks suitable from a safety perspective.

Other relevant initiatives include the European Commission's IPPA Project (Implementing Public Participation Approaches) for radioactive waste disposal. The project started in January 2011 and ended in December 2013. As part of the project, stakeholder groups in Slovenia, Poland and the Czech Republic were asked to express preferences from a 'menu' of possible benefits from each of the different project stages (siting, construction, operation and post-closure). The objective was to identify how much these responses varied. There was a degree of variation with much emphasis being placed on infrastructure development and healthcare (rather than simple cash payments).

Conclusions from IPPA included the following.

- When collating responses from all three countries it was possible to see that 1) guaranteed job opportunities for local people, 2) hypothecated funding for local infrastructure projects, 3) health care provision and 4) participation and monitoring issues are all identified as being important added value measures.
- When asking about the measures to be made available in preparing an added value approach, the majority of respondents envisaged development through multi-party negotiations, formalised in legislation. Legislation was regarded as being important in several different ways, including the provision of continuity and by also facilitating solutions through compromise when necessary. It was also hoped that the host community would have the chance to take part in preparing the legislation. According to the responses, legislation was also considered necessary to provide guarantees and to ensure a feeling of 'confidence' within the communities.
- Significantly, provision of simple cash amounts which are not hypothecated for specific purposes did not seem to draw much support. This single conclusion might be of great significance to those countries in Europe planning to use an added value approach. It is clear that stakeholders wish to see packages of benefits which continue throughout the lifetime of the facility (and which can be shown to benefit them as a community, rather than as individuals).

12.3 Infrastructure programmes

12.3.1 Spain - Centralized Temporary Storage Facility (CTS)

ENRESA (Empresa Nacional de Residuos Radiactivos, S.A.), was set up by Royal Decree in 1984 to manage radioactive waste generated in Spain. This programme has identified Villar de Cañas as the site for the CTS for the dry storage of spent fuel and HLW which will operate until a geological disposal facility is available. The siting of the CTS was based on

a willingness to participate approach, ie, communities were asked to express an interest in hosting the facility. For this process, ENRESA has a taken a multi-faceted approach to the provision of community benefits [40]. Community benefit money has been used to provide basic services and address priorities for villages, such as:

- lighting and asphalting streets
- urban development projects
- developing green zones

12.4 Institutional programmes

12.4.1 US - Waste Isolation Pilot Plant (WIPP)

WIPP began operations in 1998 and is managed by Nuclear Waste Partnership LLC on behalf of the Department of Energy (DOE). It is a geological disposal facility for transuranic wastes (broadly equivalent to long-lived ILW).

Due to an underground fire and an incident involving a waste container, WIPP has not operated since February 2014. Although the DOE was fined $73 million by the State of New Mexico for the incident, the fine has been used to pay for a number of infrastructure improvements. These are:

- $34 million: road improvements around WIPP
- $12 million: road improvements around Los Alamos National Laboratory
- $9.5 million: improvements to storm water management at Los Alamos
- $5 million: to train local 'first responder' emergency services and to build a new emergency operations centre near WIPP
- $2.75 million: independent environmental assessment of Los Alamos and WIPP Research Centre - the DOE funded the establishment and operation of the Carlsbad Environmental Monitoring and Research Centre (CEMRC) on the campus of New Mexico State University-Carlsbad

In the past, the DOE has funded the following social benefit programmes associated with the local community in New Mexico where WIPP is located.

- **Carlsbad Environmental Monitoring and Research Centre**

  The DOE funded the establishment and operation of the CEMRC on the campus of New Mexico State University-Carlsbad.
- **Advanced Manufacturing and Innovation Training Centre**

  The Advanced Manufacturing and Innovation Training Centre (AM&ITC) is a large, state-of-the-art training facility and business incubator.
- **Environmental/hazardous materials education and training programmes**

  The DOE and Washington Group International (WGI), the previous operator, helped establish environmental/hazardous material education and training programmes at three local colleges. In addition, a private university was recruited to open a branch in Carlsbad, so that employees and other people in Carlsbad will be able to earn business degrees.
- **Grant writing**

  With DOE's funding and approval, WGI offered grant writing courses to a host of educational and not-for-profit organisations located in south east New Mexico.
- **School equipment and curricula**

The DOE donated a large amount of excess computer and office equipment to local public schools. In addition, DOE funded the development and distribution of turn-key science curriculum packages to schools in the region. WGI also donated equipment and money to local schools.

- **Records centre project**

  The DOE has funded the establishment of a centre in Carlsbad designed to archive transuranic waste records not only from WIPP, but also from the DOE transuranic waste generator and storage sites located across the country. This facility employs approximately 65 people.

- **Centre for hazardous waste management excellence**

  With DOE funding and support, the City of Carlsbad established a Centre for Hazardous Waste Management Excellence. The centre will serve as a think tank and consultancy for hazardous waste issues.

- **WIPP acceleration funds**

  As designated by the US Congress, DOE has been providing Carlsbad with funding to help offset the acceleration of waste disposal (which will result in WIPP completing its legacy waste disposal earlier than originally planned). Carlsbad has used this funding to recruit a medical transcription company to open a facility in Carlsbad, help a fire-fighter training centre be established in Carlsbad and to purchase equipment for the city.

- **Technology Transfer Programme**

  WIPP's Technology Transfer Programme transferred (at no cost to the receiving organisation) WIPP-developed organisational tools, training materials, and software to more than 300 organisations in 50 communities throughout New Mexico.

12.4.2 Belgium - LLW Facility

- **Communication centre**

  A communication centre will be developed that could also be used for local community initiatives and become a meeting place for the local Dessel population.

- **Contact and support centre**

  This will be the forum for all nuclear matters including:
  - providing information;
  - setting up an ombudsman service;
  - library service; and
  - assembling all local services relating to nuclear activities.

- **Digital and interactive network (DIGICAT project)**

  This will involve the provision of technology to each family in Dessel to enable them to create a citizens' network, retrieve information and submit questions or comments.

12.5 Community grant/loan programmes

12.5.1 Finland - Spent Nuclear Fuel (SNF) [41]

- **Mansion restoration**

  These included partial funding for the restoration of a mansion with additional money contributed by the municipality and European Union. The historic building is now

partially used as the developer Posiva's offices, whilst the rest of the building is open to the public and is used as a local resource. Posiva has rented the mansion for 40 years and will pay all the rent over the first twenty years.

- **Retirement home**

  Posiva also loaned money to the municipality for it to construct a new retirement home for elderly people formerly housed in the mansion. With the rent income from the mansion, the municipality will cover the loan from Posiva. In addition, a Teollisuuden Voima Oyj (TVO - Industrial Power Corporation) loan investment will cover a local ice hockey stadium project.

- **Business development fund**

  TVO and Posiva also arranged funding for the Business Development Fund in Eurajoki during the period 1999–2004. The candidate municipalities were also asked to propose societal research subjects for the national nuclear waste research programme in the late 1990s. Five non-governmental organisations (three of them local) were funded by the Ministry of Trade and Industry for information activities in relation to spent fuel management.

12.5.2 Belgium - LLW facility

- **Intergenerational fund**

  As part of their socio-economic package, an inter-generational fund was also established to contribute to the advancement of community life and to improve the quality of the living, housing and working conditions of the inhabitants in their Municipalities. This is envisaged to be used for various projects including social, economic, cultural, environment-oriented, health and welfare. The aim of the fund will be to contribute to improving community life and encouraging creativity and originality [44].

12.6 Social and environmental programmes

This section includes examples of social and environmental programmes associated with other (non-nuclear) types of large infrastructure projects.

12.6.1 London Olympics

The 2012 Olympic Park is located in East London, an area noted for urban decline and high unemployment. From an early stage of London's 2012 Olympic and Paralympic bid it was envisioned to locate the Olympic Park in East London as the development of the Olympic Park and associated infrastructure would act as a catalyst for urban regeneration within the five host boroughs of East London. The London Development Agency (LDA) and partners were given responsibility to manage the development of the Olympic Park to improve East London's economic vitality and social togetherness.

- **Local Employment Development and Training Framework**

  The integration of local people into the Olympic Park construction phase was largely facilitated by the creation of LDA's Local Employment and Training Framework.

- **City Strategy Pathfinder**

  This programme provided construction training and employment support programmes.

- **New campuses, University of East London**

Birkbeck and Loughborough University College will further develop East London's education opportunities and encourage greater economic development into the area.

- **High performance sorting and community facilities**

  To ensure a continued socio-economics benefits legacy for East London post the 2012 Olympics, the London Legacy Development Corporation is transforming the Olympic Park into accessible multi-purpose community, leisure and cultural spaces for the East London population, while still providing world class sporting facilities for the world's best athletes. These high performance sporting and community facilities include the Aquatics Centre, VeloPark, Eton Manor (tennis and hockey centres and 5-a-side football pitches), Stadium and Copper Box (multi-use sports venue). By 2016, these combined facilities will draw over 3 million visitors per year to the park.

12.6.2 Vancouver Olympics

The Vancouver Community Benefits Agreement emerged in conjunction with the City's bid for the 2010 Olympic and Paralympic Winter games and focused, initially, on Downtown Eastside, the old commercial centre of the city. Social problems include transience and homelessness, unemployment (22%), high levels of dependence on social assistance, crime, prostitution, HIV infection, drug addiction and dealing.

- **Affordable housing**

  The historic Woodward's Building has been re-developed for housing, educational and commercial uses. The project includes 200 social housing units and 536 market housing units, which sold in a single day on the market. Affordable housing was also developed in Southeast False Creek, the 200-250 housing units used as the Athletes' Village with at least one-third of the units designated for low-income households.

- **Employment**

  A programme targeting those with 'multiple barriers to employment' has provided 200 people with one-to-one assistance with housing, childcare and counselling. Through this and other programmes, some 400 people have found work.

- **Community health**

  The Four Pillars programme to address drug-related issues has set up telephone referral services for adults and youths, a Supervised Injection Site which includes detox and referral services, and a webpage with information for service providers and the public. There are four new health clinics in the area. Deaths associated with drug or alcohol abuse, HIV/AIDS and suicides have declined since 2000 and there is less visible drug use and dealing on the street. Other measures to reduce crime and increase safety include: undercover operation targeting pawnshops, convenience stores, Standing Room Only hotels and pubs; self-defence training for street-based sex workers; and urban design improvements [42].

12.6.3 US - Long Island Green Homes programme

In the US Town of Babylon, New York, the Long Island Green Homes (LIGH) programme was implemented to retrofit existing homes for higher energy efficiency. The project was designed in Long Island's most economically distressed community to develop jobs with career pathways. Following a multi-stakeholder input process, a 'high road agreement' (an alternative type of community development agreement) was established. This consisted of engaging in a stakeholder process to identify strategies for advancing certain goals (also known as High Road Standards), a mechanism for implementing the agreement and a process for evaluating progress towards goals.

- **Job training**

  The agreement included funding a resource centre in the neighbourhood that offered training including pre-apprenticeship.

- **Energy efficiency**

  Education of homeowners about energy efficiency and the LIGH programme was provided, which reportedly increased take-up rates of the program [43, pp. 15-6].

12.6.4 Spain - CTS

- **Social welfare non-profit**

  ENRESA set up a mixed, non-profit-making charitable social welfare foundation in 1990 to provide social services to promote and develop social welfare in the municipalities within the area of influence of ENRESA's facilities. The foundation will cease activities in 2016.

12.7 Other programmes

12.7.1 Canada - Port Hope

- **Property valuation**

  Property valuation schemes have been set up in Canada for both the low-level waste clean-up in Port Hope and for LLW and ILW repository at Kincardine (see Appendix C for further detail). Funding has also been provided for a nuclear centre of excellence, trade/vocational schools and international tours.

12.7.2 Belgium - LLW facility

- **Radioactivity theme park**

  The Dessel area has been involved in nuclear activities for 50 years. Therefore, to boost tourist activities in the area STOLA (now known as STORA) proposed setting up a theme park focusing on radioactivity. It would include interactive animations, scientific shows and workshops.

- The partnership has also implemented a variety of measures as a result of the programme:
  - local health studies
  - annual health check-ups, free of charge, for all inhabitants of Dessel
  - inclusion of Dessel in future health and environmental research ordered by any governmental body
  - changing the status of the village to enable additional small and medium enterprise zones to be developed, to release existing housing development areas and to create additional building lots
  - linking up the south of Dessel with the small-town area of Mol to expand the existing small and medium enterprise zones
  - developing the N118 Motorway into an access road for traffic to reduce heavy traffic in the centre of Dessel, for transport to and from the small and medium enterprise zone, the nuclear zone and the disposal facility

12.7.3 Korea - LILW

Korea began the process of construction of a Low and Intermediate Level Waste (LILW) waste disposal facility in 2007. Community funding is to be used for:

- tourism promotion
- expansion of cultural facilities
- projects to enhance income, stable livelihood, environment and welfare
- other projects prescribed by Presidential decree for local development and improvement in local living standards
- subsidising electricity, public communication, education or for environmental or safety management
- supporting farming, fishery and tourism

12.8 Other infrastructure projects

Community Benefit Agreements for large US projects include:

- affordable housing available in 20% of the planned residential complexes
- no-interest loans available to non-profit organisations seeking to increase affordable housing
- construction of a new public park
- streetscape improvements to increase the number of trees, public benches, rubbish bins and newly paved roads
- job training programmes
- funding of public art
- a new public school and child care centre
- installation of 'bird-friendly' non-reflective windows
- development of a centralised food market (heavily desired by residents for years)
- development of a neighbourhood car park [44]

12.9 Conclusions

As demonstrated by the range of examples included in this section, additional community investment can serve as a valuable supplement to any direct socio-economic benefits associated with the GDF. Although the GDF will create jobs and facilitate economic development, it may also involve economic challenges with regard to tourism, property values and shared services. Whilst direct mitigation measures will be developed to address these challenges, additional community investment will allow the community to take stock of its own needs and strategies for development and help it to achieve its development goals. Community investment will also complement any formal mitigation that is proposed once a site is selected and acknowledge the overall commitment that the community has made on behalf of the UK.

Whilst the traditional model for assessing the socio-economic effects of infrastructure development is compliance driven, the community benefits model involves communities in the assessment process and should be viewed as a tool for managing predicted effects and for supporting and contributing to a community's socio-economic development. In addition to balancing any potential costs to the local community, this approach helps

incorporate local knowledge and concerns and secures the continuing involvement of communities in determining their futures relative to the development process [45].

13 Aggregate Socio-economic Effects

Based on the findings of this socio-economic assessment, it is clear that there will be many socio-economic benefits at the district level, associated with development of the GDF. Such a facility will create 500 to 600 direct FTE jobs. In addition, there could be between 400 and 1,000 indirect and induced FTE jobs created through knock-on economic effects, of which many could be filled at a district level. The majority of these will be skilled jobs (skill level 2), associated with safety, security, project management and construction.

In terms of economic development, the GDF is estimated to generate an additional £71-£269 million indirect and induced expenditure in the economy in an average year. Over the lifetime of the project, this equates to a total present value (undiscounted) benefit of £13.6 billion to £51.6 billion.

Potential adverse effects could include a limited reduction in property values very close to the GDF. As discussed in Section 4, the *perception* of an adverse impact on values is more likely during the planning and development phase with the impacts becoming more pronounced the longer the duration of this period. Once this period is over, however, and the facility is operational, property value reductions are likely to dissipate. Development of a PVP plan and appropriate mechanisms for compensation (if required) would help mitigate these effects.

In addition, depending on its location, tourism effects could range from an undiscounted loss of around £398 million for a rural coastal area and a loss of £1,681 million in an urban coastal area.

The actual value of costs and benefits associated with these effects remains uncertain, as the analyses included here are merely indicative and depend upon a variety of factors. However, this study has used the best available methods and data for assessing the potential socio-economic effects of the GDF.

Other general socio-economic effects of the GDF on issues such as community cohesion, agricultural sales, housing or social services are expected to result in limited changes. Many of the waste management programmes studied offer state of the art mitigation or enhancement programmes such as the property valuation schemes in Canada or the advanced public information facilities in the US, which could be applied to a community in the UK.

On balance, the results of this study suggest a significant overall socio-economic benefit to a host community. The economic development and employment results show positive effects and there is a great deal of opportunity to minimise the potential negative effects on tourism and property values through careful planning and outreach. Additional community investment will offer an additional opportunity for socio-economic improvements, driven by the vision of the local community. A review of multiple international applications of additional community investment demonstrates the broad scope and creativity of ideas and overall potential that it represents.

14 Next Steps

14.1 Community-specific assessment

During the siting process, the UK Government, devolved administrations and RWM will work with interested communities to develop a better understanding of the socio-economic implications of implementing geological disposal within their areas. This could involve producing community-specific socio-economic reports which could help communities and their representative authorities to evaluate whether hosting the GDF could significantly improve the socio-economic welfare of the area.

In addition, a monitoring strategy could be developed to ensure that the conclusions of the GSeA remain valid going forward, that any unforeseen effects are detected and any mitigation/enhancement measures are appropriately tracked.

14.2 Monitoring and managing socio-economic effects

Monitoring of the actual socio-economic effects arising from a development is important for ensuring effective use of this assessment process. Once a community has been identified, a monitoring strategy will be developed to check whether the conclusions of this generic study are valid at the project-specific level. It will build on the generic assessment provided here and will consider whether the potential mitigation and enhancement measures identified are relevant to the specific community and whether additional measures are needed. This will cover both specific practical concerns and community engagement and support.

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Glossary

A glossary of terms specific to the generic DSSC can be found in the Technical Background.

Term	Definition
Discounting	Reflects the fact that present day costs and benefits are valued more than future costs and benefits – it's a way of valuing future expenditure in terms of today's money and acknowledging future uncertainty.
Displacement	Describes the proportion of project benefits resulting from taking market share or labour, land or capital from other existing firms or organisations. For example, increasing the activity of local businesses to supply the GDF may use up local labour and resources, resulting in an increase in prices for those inputs.
Leakage effects	The number or proportion of outputs that benefit those outside of the intervention's target area or group.
Economic linkages	The degree to which a local economy can provide the goods and services a project needs.
Direct spending	Money invested directly into the construction/operation of the GDF.
Substitution effects	The effect arises where a firm substitutes one activity for a similar one (such as recruiting a jobless person while another employee loses a job) to take advantage of public sector assistance.
Economic multiplier effects	The economic effects of an intervention are multiplied because of knock-on effects within the economy. Two types of multipliers are used here: - a supply linkage multiplier (sometimes referred to as an indirect multiplier) due to purchases made as a result of the intervention and further purchases associated with linked firms along the supply chain; - an income multiplier (also referred to as a consumption or induced multiplier) associated with local expenditure as a result of those who derive incomes from the direct and supply linkage impacts of the intervention. Depending on the data available, multiplier effects can be applied to jobs, output, income or Gross Value Added.
Property Value Protection	A scheme put in place to help mitigate against adverse property value impacts attributable to the planning, siting and development of the GDF. It could comprise consultation with affected stakeholders as well as compensation mechanisms.

Appendix A – Employment

A1 Introduction

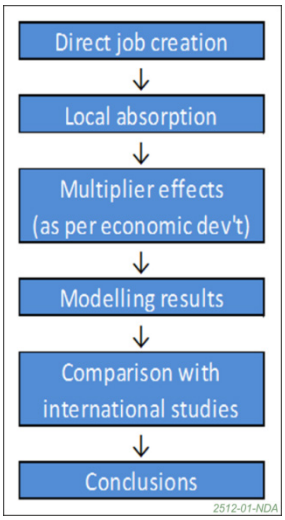
This appendix contains information on direct employment and how direct jobs will be distributed across different skill levels. It also contains estimates of consequent indirect and induced job creation at a district, regional and national level.

- 'Direct jobs' refers to employees that work directly on the GDF project (they may be based within a local area or classed as 'commuters' with their residence outside the area).
- 'Off-site jobs' are where employees have roles that are directly linked to operations at the GDF but may not be located at the GDF site itself (primarily comprising office-based work that is assumed to be undertaken at an RWM office or similar location – possibly outside the host district).
- 'Indirect jobs' refers to employees of suppliers for the GDF project (such as steel and concrete manufacturers).
- 'Induced jobs' refers to jobs created by the spending of salaries for items such as food, fuel or entertainment.
- 'Job leakage' is where a skill requirement is met by an employee from outside the district or region.
- 'Displaced / dislocated workers' are employees that lose their jobs because the company / operations have closed, relocated or been abolished, or their role is no longer required. 'Displacement' and 'substitution' effects are closely related. They measure the extent to which the benefits of a project such as the GDF are offset by reductions in output or employment elsewhere.

A2 Approach

A large infrastructure project, such as the construction of the GDF, will have an effect in the host community, the wider region and nationally in terms of job creation. New jobs will result from direct employment, that is, people directly employed in the planning, construction, operation and eventual closure of the facility; from jobs supported in the supply chain (indirect jobs); or as a result of induced spending in the wider economy (induced jobs). Not all direct jobs will be taken up in the district hosting the GDF. In addition to those classified as 'offsite', some jobs will attract residents from outside the host community who may decide to commute to the GDF facility location rather than move to the area or district.

The overall approach to the employment analysis presented in this appendix involved the following steps:



Employment projections included in this analysis are considered to be part of general economic development associated with radioactive waste management in the UK; they are not additional to the results presented in the Economic Development analysis. The methodology followed in this analysis is based on the UK Treasury's 'Green Book' [46] and the Homes and Communities Agency's 'Additionality Guide' [47].

Calculations used:

Net direct local effects = {[gross direct effects – leakage from target area/group]-displacement (factor/product market)/substitution}

This analysis attempts to estimate the net employment effects of the project by taking account of leakage and displaced worker effects.

*Net local effects = net direct local effect * indirect multiplier + net direct local effect * induced multiplier*

Where:

- gross direct effects are based on the data presented in the NDA 2012 report 'Geological Disposal: Development of Manpower and Skills Data'
- leakage and displacement estimates are based on general, non-sector specific guidance percentage values from the HMT Green Book and the Homes and Communities Agency's 'Additionality Guide', and are applied to the context of the GDF project by analysing the skill level and job context of the jobs created
- indirect and induced effects multipliers from the economic development analysis are carried through to determine the net effect at a district, regional and national level; where district and regional multipliers are 'bottom-up[11]', non-sector specific estimates and the national multipliers are 'top-down[12]' and sector specific due to data restrictions

If geological disposal is not implemented, the baseline assumption (the 'counterfactual') is that on-going surface storage of the wastes would be required at various locations throughout the UK. It is difficult to predict what this baseline scenario would mean in terms of employment. However, over a similar timeframe to the construction and operation of the GDF, the on-going maintenance and management of storage facilities (rather than their progressive closure and decommissioning as waste is transferred to the GDF) is unlikely to

[11] Starting with the smallest geography and proceeding to the largest geography.

[12] Starting with the largest geography sector and proceeding to the smallest geography.

involve a significant number of jobs. The 'net' employment effect of implementing geological disposal is therefore likely to be only slightly less than the forecasts presented in this analysis.

A3 Direct Job Creation

A3.1 Approach to direct job distribution

Manpower requirements from the NDA 2012 manpower and skills analysis (and addendum) were used as a basis for the employment projections.

There are five skill levels distributed across ten job contexts / categories associated with the disposal facility.

The five skills levels are:

- skill Level 1 – Semi-skilled
- skill Level 2 – Skilled
- skill Level 3 – Technician
- skill Level 4 – Management / Professional
- skill Level 5 – Senior Management

The ten job categories are: Decommissioning Operations; Safety and security; Radiation protection; Project management; Engineering design; Scientific and technical support; Business, Construction (internal estates); Estate and Repository Operations and Commissioning.

These were assumed to be a mix of nuclear-industry specific roles and more general (non-nuclear) roles. The split between 'nuclear industry' and 'non-nuclear industry' roles is based on the employment data and professional judgement given the typical employment characteristics in this sector. The results are shown in Table A1 below. These categories are used in determining the likely level of job leakage[13] and displacement at a district and regional level.

In Table A1, the average number of jobs per year is shown, and is divided into those jobs classified as 'On-site' and 'Off-site', where Off-site represents primarily office-based work that could be accomplished at any appropriate location. For the purpose of this assessment, Off-site jobs are assumed to be located at RWM Headquarters or another location outside the district of the host site. A sensitivity analysis has been undertaken to consider the effect of providing all the direct jobs on-site within the host district (see Section A3.4).

[13] If a certain job skill category is not available locally it may attract someone from outside the District to undertake the role (leakage).

Table A1 NDA direct jobs

Skill Level	Siting process (15 years)	Construction (15 years)	Construction and operation (150 years)	Closure (10 years)
On-site				
Nuclear sector specific job context				
Skill level 1	0	0	5	0
Skill level 2	5	0	102	25
Skill level 3	41	20	52	30
Skill level 4	8	26	20	0
Skill level 5	3	0	1	0
Not nuclear sector-specific job context				
Skill level 1	1	0	10	0
Skill level 2	69	374	203	0
Skill level 3	54	141	14	0
Skill level 4	2	26	44	20
Skill level 5	0	0	5	0
Off-site				
All skill levels	255	250	123	113
Total Jobs				
All skill levels	438	837	579	188

A3.2 Leakage and displacement at district and regional levels

To determine how new jobs might be supported at a district and regional level by the GDF, the manpower requirements for the full project are considered in the local context of typical districts and regions.

For this generic study, it is not possible to determine precise leakage and displacement levels, therefore qualitative judgment is required. To estimate likely levels of leakage and displacement, the following two qualifications were applied:

- Without knowledge of the specific area, leakage and displacement estimates have been merged to create a joint absorption metric. This is because absorption of jobs by the local population will be constrained by local unemployment levels. In other words, applicants who are currently employed or from outside the area will constitute either displacement or leakage. Therefore,

  Absorption = gross direct on-site job creation – leakage – displacement

- Lower absorption rates are envisaged for nuclear specific job contexts. As previously described, the job contexts for the Project were divided into nuclear sector specific, and 'generalist' as shown in Table A2:

Table A2 NDA job context categories

Job Context	Nuclear Sector-Specific Context[14]
Decommissioning Operations	Yes
Safety and security	No[15]
Radiation protection	Yes
Project management	No
Engineering design	Yes
Scientific and technical support	Yes
Business	No
Construction (internal estates)	No
Estate and Repository Operations	Yes
Commissioning	Yes

In addition, the skill requirements for direct jobs are expected to affect whether or not a job is taken up locally for two main reasons:

- unemployment levels for the lower skilled are relatively higher
- filling a position at a higher, more specialised, skill level may require searching employees across a wider geographic radius to meet the exact requirements of the job

In determining the likely leakage and displacement estimates for the lower skilled 'generalist' job contexts, unemployment at district and regional levels was estimated using 2011 ONS data.

This qualitative assessment led to the absorption estimates presented in Figure A3. The values reflect the fact that non-nuclear sector, lower skill level jobs are likely to be filled at a district level without creating leakage and displacement. As the skill level increases and local unemployment decreases, it can be assumed that manpower requirements will be met through leakage and / or displacement.

Figure A1 and Figure A2 show low and high district absorption levels - the higher the district absorption then the lower the number of remaining jobs to be absorbed at a regional or national level.

These absorption estimates were further adjusted based on a conservative approach to reflect the fact that once a job is not filled from within a host district, it is then as likely to be filled from within the same region as it is from the national level. For example, if a construction worker is to relocate to take up a job at the GDF, he or she could just as likely originate from the same region as from elsewhere in the UK (and indeed the wider EU). As a result, a conservative judgement-based ceiling of 50% regional absorption was applied. Where estimates would exceed this, on-site direct job creation was split equally at regional and national levels. As previously stated, all Off-site jobs are assumed to occur outside the host district.

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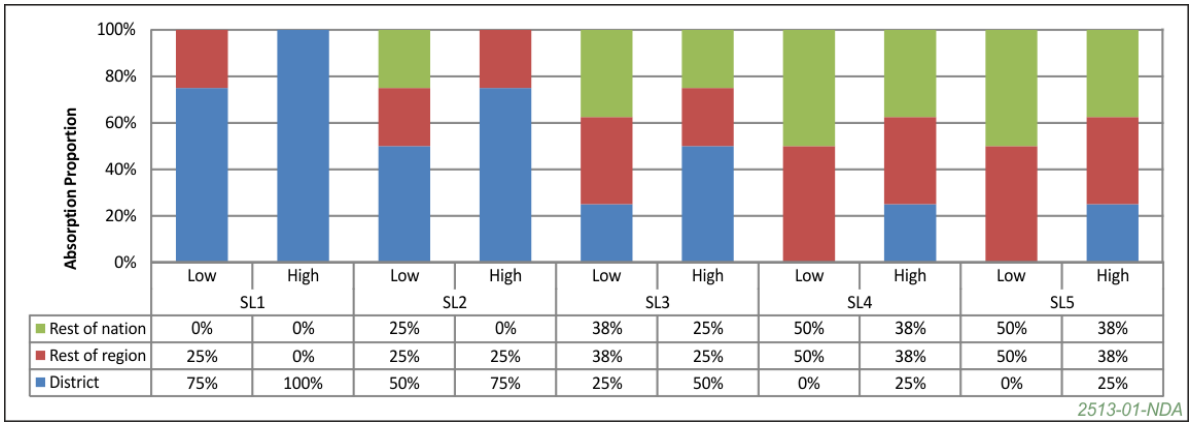
14 These are professional assumptions.

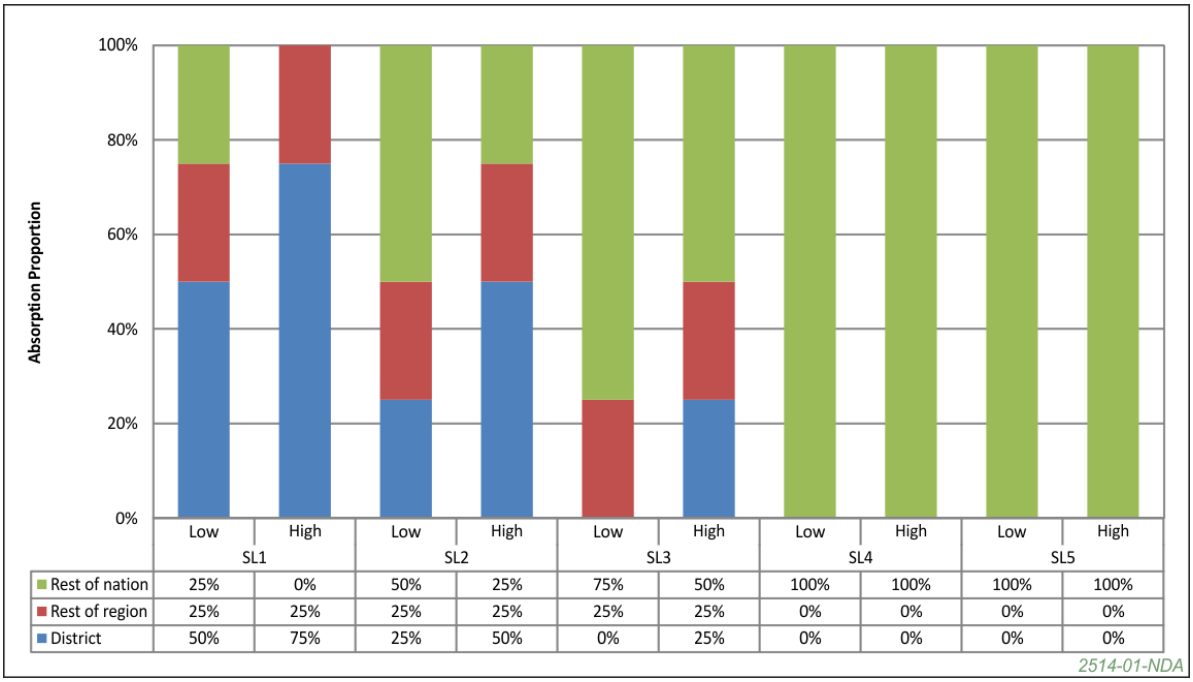
15 For safety and security it has been assumed the task involves aspects such as patrolling / surveillance and so can be applied to any sector and is not nuclear sector specific.

Figure A1 Direct job absorption distribution: 'Generalist' job contexts



	SL1 Low	SL1 High	SL2 Low	SL2 High	SL3 Low	SL3 High	SL4 Low	SL4 High	SL5 Low	SL5 High
Rest of nation	0%	0%	25%	0%	38%	25%	50%	38%	50%	38%
Rest of region	25%	0%	25%	25%	38%	25%	50%	38%	50%	38%
District	75%	100%	50%	75%	25%	50%	0%	25%	0%	25%

Figure A2 Direct job absorption distribution: nuclear sector specific job context



	SL1 Low	SL1 High	SL2 Low	SL2 High	SL3 Low	SL3 High	SL4 Low	SL4 High	SL5 Low	SL5 High
Rest of nation	25%	0%	50%	25%	75%	50%	100%	100%	100%	100%
Rest of region	25%	25%	25%	25%	25%	25%	0%	0%	0%	0%
District	50%	75%	25%	50%	0%	25%	0%	0%	0%	0%

A3.3 Direct job distribution results

The job distribution results that emerge from the analysis are displayed for the different skill levels in Figure A3. It can be seen that a higher proportion of lower skilled jobs are captured within the district, with far fewer high skill jobs presumed to be absorbed at a district level.

Table A3 shows how the direct jobs are expected to be realised over the phases of the project. These figures highlight the significant direct employment effects that will be realised at a district level, particularly during the Construction and Construction & Operation phases. As can be seen, the average direct employment peaks during the Construction phase at a total of 837 jobs, of which approximately 300 jobs are absorbed at a district level (the midpoint between the low and high scenario being approximately 293 jobs).

Figure A3 Average on-site direct jobs: by skill level

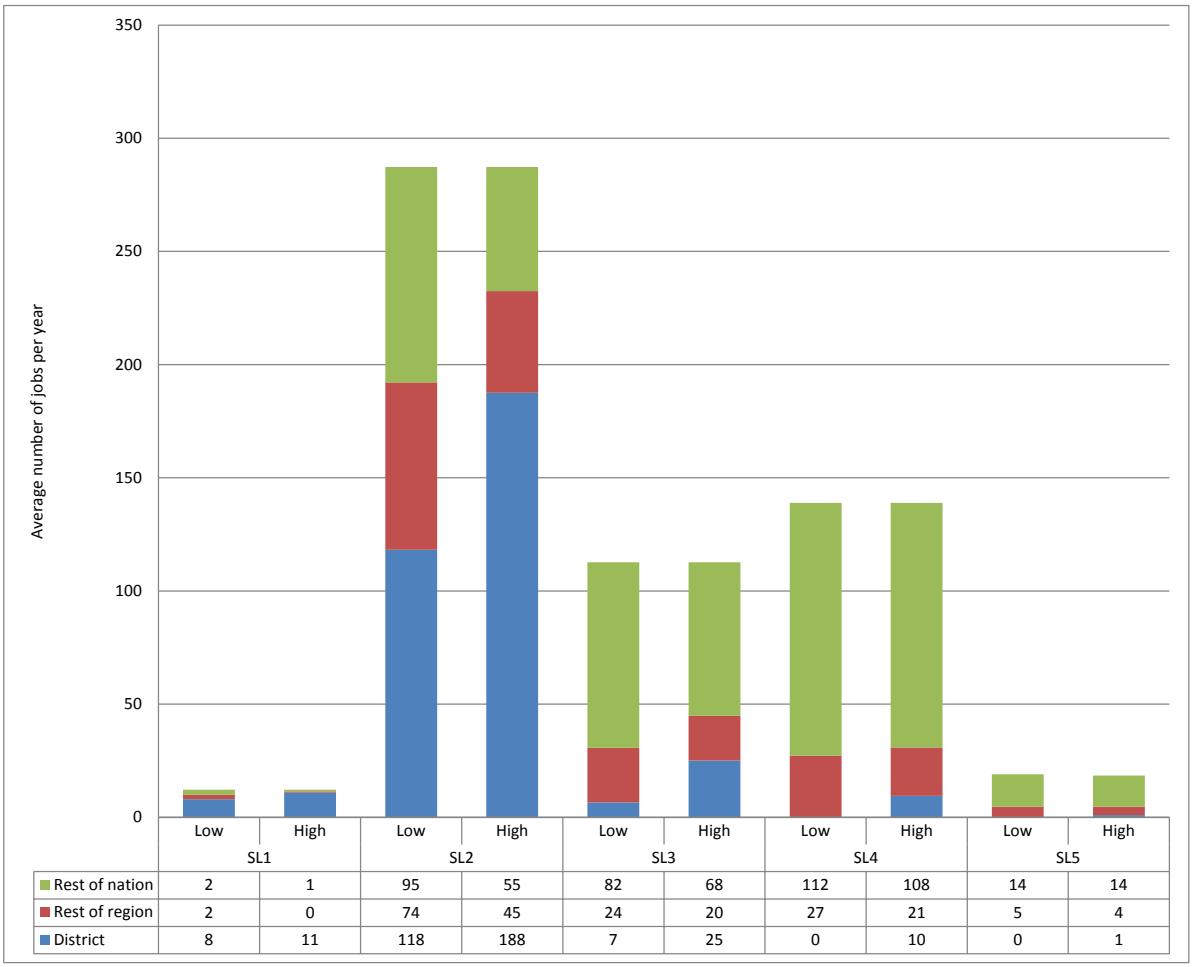


Table A3 Job absorption results – total direct jobs by phase

Geographic distribution summary	Siting process		Construction & underground based investigation		Constr. & operation		Closure		Average over duration	
	Low	High	Low	High	Low	High	Low	High	Low	High
Years	**15**		**15**		**150**		**10**		**190**	
District	50	93	222	363	141	249	6	25	133	234
Rest of region	62	40	182	109	138	96	24	21	129	89
Rest of nation	71	50	182	116	177	111	45	29	162	102
Sub-total On-site	*183*	*183*	*586*	*588*	*456*	*456*	*75*	*75*	*425*	*425*
National Off-site	255	255	250	250	123	123	113	113	143	143
Total	**438**	**438**	**837**	**837**	**579**	**579**	**188**	**188**	**568**	**568**

A3.4 Sensitivity testing

An analysis was undertaken to consider the effect of providing all the direct jobs on-site within the host district. This analysis shows that providing all of the jobs on-site results in an increased number and proportion of jobs realised within the district. For example, of the phase average of 837 jobs generated during the Construction phase, approximately 350 will be absorbed at a district level. Based on the employment impact calculations (and multipliers used), this means that 17% more jobs will be absorbed at a district level than would otherwise be the case.

A4 Indirect and Induced Employment Effects

A4.1 Approach to indirect and induced employment effects

This part of the analysis looks at how the GDF, through supply linkages in the economy and induced spending, will support further employment beyond those directly employed.

'Type I' multipliers capture the indirect effect on employment as a result of increased supply chain activity. 'Type II' multipliers capture the induced effect on employment caused by the proportion of increased income (arising from both direct and indirect employment) spent on goods and services. Type I multipliers are focused on the backward linkages created by new business in an economy. For example, building a new house might create spin-off effects in the construction material sector. Type II multipliers take into account both the indirect effects of new economic activity and induced effects, which are linked to increased consumer spending. Therefore, Type I multipliers tend to be more sector specific whereas Type II multipliers are generally more of a composite.

Because of the unique nature of the project, no GDF specific employment multipliers are available for the UK. Information from reviewing international studies suggests that these are likely to be similar in magnitude to output multipliers for the UK construction and mining sectors, which are shown in Table A4 and Table A5 below.

Table A4 Multipliers taken from the Additionality Guide[16]

Type II	District[17]	Region
Low (limited local supply linkages)	1.18	1.3
Medium (average linkages)	1.30	1.5
High (strong local supply linkages)	1.43	1.7

16 Source: Additionality Guide, Homes and Communities Agency, 2014.

17 Based on an average of the multipliers for small 'neighbourhoods' and larger 'regions', as districts were felt to be between these in size.

Table A5 Multipliers from the UK mining and construction sectors

Sector	Type I[18]	Type II[19]
Construction	2.141	2.89
Metal ores extraction, other mining and quarrying	1.992	2.69

These multipliers were applied within the analysis as follows:

- At a district level, only direct jobs absorbed within a district were used to determine induced effects, as it was assumed these jobs are directly related to increased disposable income in the district. Consistent with good practice, the total number of on-site jobs projected was used as the basis for indirect job projection.
- At a regional level, indirect jobs were determined based on the total number of direct on-site jobs, while induced jobs were calculated based on direct jobs absorbed within the rest of the region. Off-site jobs were assumed to be supported outside the region and, therefore, further effects are expected to occur at a national level. However, this assumption was subject to a sensitivity test (see Section A4.3).
- At a national level, the indirect effects were calculated by multiplying the total number of jobs by the sector mining and construction multipliers which were used depending on the project phase. The bottom-up calculations of the district and regional effects were then subtracted from this. The induced effects were calculated using the mining and construction sector multipliers. These calculations are based on the remaining direct jobs after district and regional absorption.

A4.2 Indirect and induced employment results

In determining the indirect and induced employment effects of the GDF – that is, the sum of the indirect and induced effects at a district, regional and national level; low, medium and high scenarios were created by combining the absorption scenarios of the direct jobs with the multiplier scenarios, as shown in Table A6.

Table A6 Composite scenario description

Composite scenario – added effects	District absorption scenario	Multiplier scenario
Low	Low	Low
Medium	Average between low and high	Medium
High	High	High

Table A7 and Figure A4 show the low and high estimates for indirect and induced employment. The indirect and induced jobs supported through economic multiplier effects are much greater at the national level than the regional or district level during all phases. This is to be expected due to the higher multipliers that are assumed at the national level. Another result is that a significant proportion of the total indirect and induced employment

18 Source: ONS Input Output Tables, 2005.

19 Source: Generated following literature review.

resulting from direct regional level employment will in fact be realised within the host district.

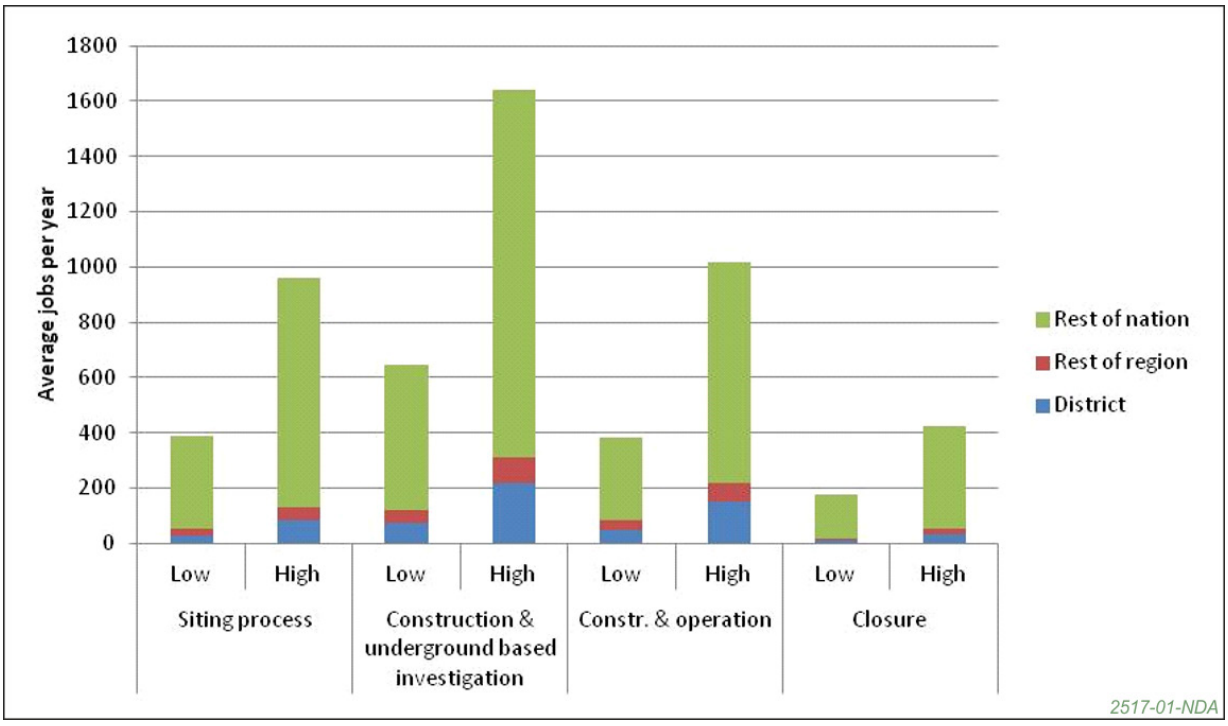
The indirect and induced employment supported can be compared between phases and contrasted with the direct employment results. The mid-level estimates for indirect and induced jobs (averaged over the low and high figures below) are between 135% and 175% of the direct job creation estimates shown in Table A1.

The results show that both proportionally and in actual terms, the Construction and Construction & Operation phases will provide the highest levels of local employment, and that in all cases, the jobs supported at a district level will be greater than those realised regionally.

Table A7 Indirect and induced employment results

Geographic distribution summary	Siting process		Construction & underground based investigation		Constr. & operation		Closure		Average over duration	
	Low	High	Low	High	Low	High	Low	High	Low	High
Years	**15**		**15**		**150**		**10**			
District	30	85	72	217	48	149	11	32	46	142
Rest of region	22	45	48	92	34	68	9	20	33	65
Rest of nation	337	831	524	1333	292	784	156	370	343	904
Total	**389**	**961**	**644**	**1642**	**374**	**1001**	**177**	**422**	**422**	**1111**

Figure A4 Average number of indirect and induced jobs per year at national, regional and district levels



A4.3 Sensitivity testing

An analysis was undertaken to consider the effect of providing all the direct jobs on-site within the host district. This analysis shows that providing all of the jobs on-site results in jobs generated at a district and regional level increasing by as much as 20%. This would be offset, however, by lower job generation at a national level, with the total number of jobs being generated dropping by as much as 10%[20].

A4.4 Insights from other international GDF studies

Employment estimates from the following geological disposal projects were reviewed to provide some context for this analysis and to allow benchmarking.

US DOE – 2008 [48]

In the United States, Yucca Mountain, in Nye County, Nevada was chosen as the preferred site for a deep geological repository. The repository was set to receive a statutory limit of 77,000 metric tons of waste within 64km of tunnels. The site characterisation phase ended in July 2002 with plans for first waste emplacement by 2010 – after an 8 year construction period. However, this plan was not realised due to the withdrawal of federal funding in 2008 [49]. Studies predicted that during the construction phase the repository would have employed each year around 1,700-2,500 workers on-site and off-site. After displacement, indirect and induced effect adjustments the total number of jobs was estimated to be between 580 to 1,190 jobs during the construction phase. Most of the jobs at a county level would have been created in the construction, professional and technical services, retail trade and food and beverage industries.

During the operational phase, it was estimated that direct site employment would have ranged from 2,000 jobs (construction and waste emplacement) to about 1,500 jobs (waste emplacement only). At a county level, accounting for displacement, indirect and induced effects, this was expected to support about 1,700 new jobs in the construction and waste emplacement phase and 1,650 jobs in the waste emplacement only phase.

It is not possible to derive specific leakage and displacement or multiplier effects from the US study due to the aggregated reporting of results, although it is obvious that during construction locally supplied new job creation is limited compared to the total direct job creation; this ratio increases during the operation phase. This would suggest that there was sufficient capacity within the local area to absorb the project requirements during the construction phase.

BFE 2012 – Switzerland [50]

Development of a GDF for Swiss wastes is being led by the UVEK (Eidgenössisches Departement für Umwelt, Verkehr, Energie und Kommunikation - Federal Department of the Environment, Transport, Energy and Communications, Switzerland) and BFE Switzerland (Bundesamt für Energie – Federal Office of Energy). A 2012 report considered siting options and associated socio-economic effects for three Swiss regions and for three types of facilities: a deep geological repository for low-level and ILW, a deep geological repository for HLW and a combined repository for low, intermediate and high level waste.

According to the study, an estimated 35 to 45 full-time equivalent jobs will be created in the respective siting region for a low-level and intermediate-level facility. For a deep GDF for high-level radioactive waste, the figures increase to 109 to 120 full-time equivalent jobs. For the combined facility, a range of 139 to 153 jobs is estimated. These figures are averaged over the 94 year duration of the facility.

[20] This is a result of the different multipliers used at the different geographic levels.

It is possible to deduce the regional multipliers used to calculate indirect and induced employment from the table below.

Table A8 Employment estimates for a combined facility, by region

Type	Jura Ost	Nördlich Lägern	Zürich Nordost
Population, '000	133	134	103
Direct On-Site employment	59	59	59
Direct Off-Site employment	53	48	43
Additional indirect	12	11	10
Type I employment multiplier	*1.11*	*1.10*	*1.10*
Additional induced	29	29	27
Sub-total indirect and induced	40	40	37
Type II employment multiplier	*1.37*	*1.37*	*1.23*
Total employment	153	147	139

As shown in Table A8, a 10% absorption rate of backward supply linkages was applied on the basis of the Swiss Input-Output model, generating a Type I employment multiplier of 1.1. A slightly higher figure of 1.11 was applied in the Jura-Ost region due to its higher population; employment level and industrial gross value added (GVA)[21].

The Type II Employment multiplier is the same for Jura Ost and Nördlich Lägern, at 1.37, but lower for Zürich Nordost where the labour participation rate is lower and induced consumption relies more heavily on imports to the region.

The multipliers used in the study are broadly higher than those used in some international studies. This is because UK data and good practice guidance has been used - which reflects an assumption that relevant economic linkages are considered to be more established in the UK (that is, the UK economy is able to supply a greater proportion of the goods and services likely to be needed by the GDF project).

Posiva 1999 – Finland [51]

Posiva Oy is the jointly-owned Finnish company responsible for development of a GDF for spent nuclear fuel from the nuclear plants at Olkiluoto and Loviisa, Posiva is currently constructing the Onkalo spent fuel repository, the world's first deep geological repository, at the Olkiluoto Nuclear Power Plant site.

As part of the environmental impact assessment report undertaken in 1999 (when different locations for the repository were under review), an employment analysis indicated the numbers and types of jobs likely to be created.

[21] Gross value added (GVA) is a measure of the relative value of goods and services produced in an area, industry or sector of an economy. At a micro-level, GVA is the contribution of each individual producer, industry or sector to the economy. At an aggregate macro-level it provides a summary measure of the complex interactions of the economy.

When comparing the Finnish repository with the GDF proposed in the UK, it is important to note that the Finnish facility is considerably smaller as it is designed solely for spent fuel (whereas the inventory for disposal in the UK will accommodate ILW, HLW and spent fuel).

Given that the UK site could mean a subsurface footprint up to two to three times as large as the Finnish facility (albeit with similar surface facilities), the following estimated employment metrics should be viewed in context. During the construction phase, approximately 30 to 70 jobs were anticipated whilst the effect on employment will primarily be directed towards other municipalities with the 'sphere of impact'. These will total approximately 80 jobs.

In the area as a whole, approximately 110 to 150 jobs will be supported whilst in the province as a whole, 170 to 230 jobs will be supported. In broad terms, this latter overall impact is similar to the impacts derived from the multipliers representing the UK mining and construction sectors. Similarly, taking the Finnish 'area' to be broadly similar to a UK 'district', the implied Finnish area multiplier above (1.6) is broadly consistent with the multiplier values in the UK Additionality Guide.

OPG 2013 – Deep Geologic Repository Project, Canada [52]

Ontario Power Generation (OPG) is planning a Deep Geologic Repository (DGR) for low and ILW from its reactors. In May 2015, the Environmental Assessment (EA) Report was issued and this recommended approval of the DGR to the federal government.

Given that the facility is only intended to accommodate LLW and ILW, it will be considerably smaller compared to the proposed GDF in the UK. The footprint for the DGR would be about 1.35 kilometres by 1.36 kilometres whereas the footprint of the GDF in the UK could be up to 16.5 square kilometres.

The difference in scale between the two projects is reflected in the employment impact estimates for the OPG facility. Site preparation and construction will require between 80 and 200 workers annually over 6 years, operations will support 40 jobs over 40 years and decommissioning will support 4 to 125 jobs over 7 years.

Of the total workforce over the combined period (53 years), approximately 27% will work within the Local Study Area (LSA) whilst a further 24% will work in the Regional Study Area (RSA). In the socio-economic technical information session of March 2013, a total of 25,000 Full Time Equivalents (FTEs) were estimated across the 53 year overall project timeframe. This means that almost half of total employment will be supported within the wider Ontario area and beyond. Since these jobs in the wider area are likely to be in 'support' industries, this implies a multiplier of 1.96 between employment in the local / regional area and that beyond.

A5 Conclusions

The objective of this analysis is to provide a broad understanding of the potential employment opportunities which may result from the development of the GDF. Given it is not a geographically specific analysis the results must be considered to be uncertain. Once candidate communities come forward and, eventually, a site for GDF is selected, geographically specific analyses can be undertaken to refine the assumptions applied and progressively increase the level of certainty in the analysis.

Based on current assumptions about how geological disposal might be implemented, the employment analysis indicates that, in broad terms, up to 1600 jobs will be supported - as an annual average over the lifetime of the GDF.

- About 500 – 600 will be direct jobs, that is, people directly employed in the planning, construction, operation and eventual closure of the facility.

- Of these direct jobs, approximately 150 are assumed to be off-site jobs where employees have roles that are directly linked to operations of the GDF but may not be located at the GDF premises. The remaining direct jobs will be located within the host district.
- A further 400-1000 jobs will be supported in the supply chain (indirect jobs) or as a result of increased spending in the wider economy (induced jobs).
- With implementation of initiatives to support development of the local skill base, 500-700 of the total FTE jobs could be available at a local (district) level. The remainder of the jobs would be supported at a regional or national level. The employment analyses undertaken for geological disposal facilities in Switzerland and the US suggest that job creation is more likely to be at the higher end of the scenarios considered here. However, the socio-economic profiles of the areas studied are likely to be quite different from potential host communities in the UK.

A5.1 Enhancement opportunities

There are initiatives that could be adopted to make the most of employment opportunities at a local (district) level. Many of these have a history of success in in the context of other long-term infrastructure developments and include the following.

- Development of a Workforce Development Strategy – a commitment to maximise employment and skills opportunities for local people.
- Development of a training and skills programme to impart best practice in the skilling of local people for construction and operational jobs.
- Encouraging contractors to provide apprenticeship opportunities to local people and encourage supply chain partners to recruit local people.
- Establishing a local job readiness programme and encourage the construction supply chain to continue to invest in workers.
- Establishing a local employment brokerage that will publicise job vacancies and put in place initiatives to ensure employment opportunities for hard to reach groups.

Indirect and induced employment is enhanced when a local community and region is more highly linked into the supply chain of the industries involved in a project. Given the long lead in time and long term nature of the GDF, there will be ample opportunity for local businesses to take advantage of the opportunities provided and it might be expected that employment effects at a local level will improve through time.

Appendix B – Economic Development

B1 Introduction

This appendix contains estimates of the distribution of induced and indirect economic expenditure at the district, regional and national level that results from direct spending on the GDF project.

The effects of the GDF on economic development are considered primarily through the likely spin-off effects that the direct spending and employment at the facility will have on the economy through backward supply linkages (indirect effects[22]) and induced household consumption by the direct employees and suppliers to the facility (induced effects[23]). These combined effects are commonly referred to as multiplier effects.

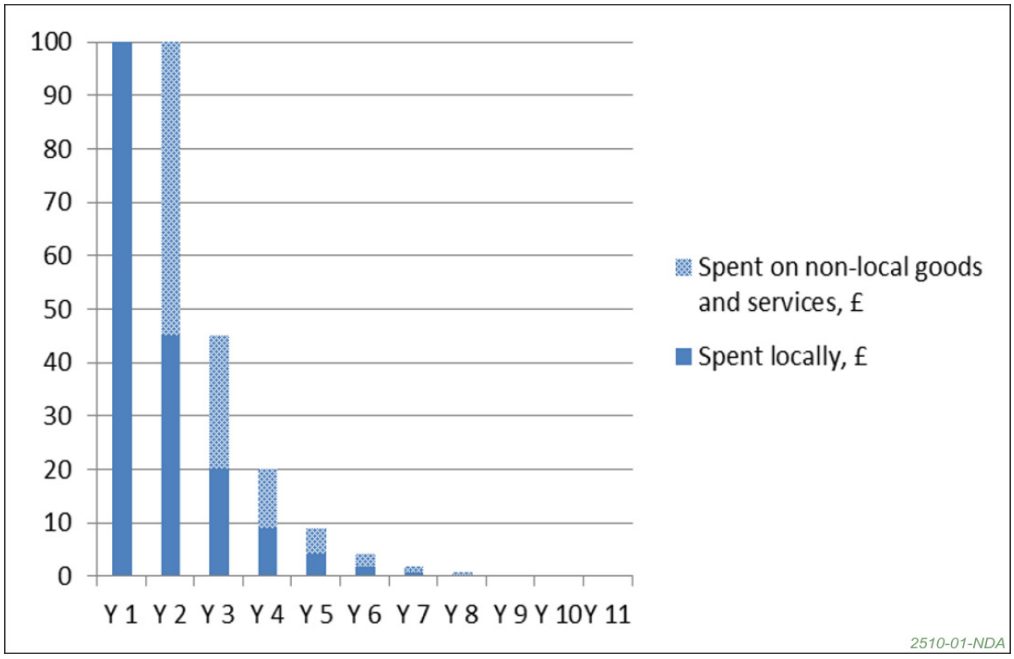
B1.1 Background on multipliers, economic growth and employment

Spending an extra pound in a geographic area or creating a new job leads to 'spin-off effects' in the economy, due to what economists call multiplier effects (explained above); these are illustrated in Figure B1 below. Supposing that £100 is spent in a local economy in year 1, a portion of this additional income will be spent or re-circulated in the economy in the following year. Depending on the size of the area and its production mix, some of the additional income will be spent locally, and some will be spent on imported goods. In Figure B1 it is assumed that 45% of additional income is spent on local goods and 55% on imported goods. Therefore, in year 2, the initial £100 expenditure will bring an additional £45 to the local economy, in year 3 - £20.25. In total the additional money brought to the local economy will add up to about £82 per £100 over approximately 8 years.

22 Indirect effects are re-expenditure into the economy through the supply chain, for example the effects of purchasing construction materials.

23 Induced effects are the changes in economic activity resulting from household spending of income earned directly or indirectly from the project, for example money spent by construction workers in the community.

Figure B1 Illustration of multiplier effects [53][24]



Multipliers can be calculated on the basis of additional output, gross value added, number of jobs created or expenditure on new jobs. Value added multipliers include the added contribution of spending on employment, indirect taxes on economic activity and other property income.

All multipliers take the form of a ratio:

$$k = \frac{\text{total change}}{\text{initial change}}$$

In the example above, the multiplier is equal to $\frac{£182}{£100} = 1.82$.

B1.2 Multiplier types

Three types of multipliers are commonly used.

B1.2.1 Type I multipliers

Type I multipliers are focused on the backward linkages created by new business in an economy. For example, building a new house might create spin-off effects in the construction material sector. These are calculated following the principle above:

$$\text{Type I multipliers} = \frac{(\text{Direct effect} + \text{Indirect Effect})}{\text{Direct effect}}$$

Type I multipliers are based on the linkages between sectors in a certain region or country as well as the ratio of locally produced and imported goods. Type I multipliers are typically produced at the national level as financial transactions as well as international trade are not recorded at the regional level. Regional Type I multipliers are therefore often based on national statistics and are highly uncertain. As production changes over time, supply chains and multiplier estimates change too; however, the following rules of thumb apply:

[24] This figure illustrates the effect of spending in Year 1 only; whereas direct expenditure for a GDF would continue throughout the project duration.

- Regional and local community multipliers will always be lower than or equal to national multipliers;
- The size of the multiplier is likely to be directly related to the size of the geographic area considered – that is, goods are more likely to be sourced locally if the local area is larger and economically vibrant; and
- The size of the multiplier will vary from region to region, depending on the structure of the regional economy and the type of project considered – for example, if a house is built in an area that does not have a construction material supply industry, the indirect effects (Type I) multiplier for this sector will be nil.

B1.2.2 Type II multipliers

Type II multipliers take into account both the indirect effects of new economic activity and induced effects, which are linked to increased consumer spending. In project appraisal, the following formula can be applied:

$$k = \frac{1}{1 - [1 - \mathrm{c}(1 - \mathrm{t}) + \mathrm{m}]}$$

where:

k – regional or local multiplier

t – tax rate

c – propensity to consume or the proportion of disposable income that is not saved

m – propensity to consume imported goods.

Type II multipliers are calculated as follows:

$$\text{Type II multipliers} = \frac{(\text{Direct effect} + \text{Indirect Effect} + \text{Induced Effect})}{\text{Direct effect}}$$

Induced effect multipliers are determined on the basis of a consumption bundle[25] at a given income level. However, as incomes increase, consumption bundles and therefore the proportion of local versus imported goods might change, leading to the creation of Type III multipliers.

B1.2.3 Type III multipliers

Type III Multipliers are a modification of Type II multipliers and take into account consumption bundle changes that occur as income increases. These are produced less frequently and are not considered as part of this generic assessment.

B1.2.4 Sector multipliers

Multipliers are derived for each sector of the economy. The size of the multiplier depends on the backward linkages within the economy and whether the sector is supplied domestically or internationally. Given that no specific multipliers for geological disposal of radioactive waste currently exist, this analysis relies upon construction and mining sector multipliers. This is because these multipliers are considered to be broadly analogous to similar impacts in the nuclear and radioactive waste sector.

[25] A consumption bundle is a combination of goods and services or activities that an individual buys or pursues during a given period.

B2 Approach

The methodology applied here is specifically tailored to this project and may not be considered a 'typical' assessment for three main reasons:

- it applies to a type of activity that has not been undertaken in the UK before
- there is no specific geographic area which the assessment is focused on, therefore general assumptions need to be made
- the duration of the project (approximately 190 years) is very long compared to other assessments

In the assessment, multipliers are added to the local (district), regional or national economy as a result of an initial increase in spending or employment. Next, quantitative results are presented in the context of key uncertainties. The conclusion summarises and presents additional economic development impacts.

B2.1 Insights from International GDF Studies

The application of economic multipliers to the GDF has been informed by an international literature review undertaken for comparable projects.

B2.1.1 AECOM 2011 – Canada

In a 2011 study carried out by AECOM for Ontario Power Generation's proposed Deep Geologic Repository near Bruce [54], multipliers for the construction sector were used for the site preparation, construction and decommissioning phases. The operational phase was believed to be roughly analogous to the mining sector in activity structure and backward linkages. The multipliers in Table B1 were derived at the national level:

Table B1 National multipliers for OPG's Deep Geologic Repository

National Multiplier	Site preparation, construction and decommissioning (Construction)		Operations (Mining)	
	Type I	Type II	Type I	Type II
Labour Income	1.56	2.81	1.57	2.82
FTE jobs	1.50	2.61	1.80	3.74
Gross Output	1.52	2.42	1.43	2.26

No regional or local multiplier effects in terms of increased output and spending were developed as part of the AECOM report.

B2.1.2 Bundesamt Für Energie (BFE) - Switzerland

The socio-economic effects of geological disposal are considered in a BFE 2012 report which analyses siting options in six Swiss regions for three types of facility: a deep geological repository for low-level and intermediate-level waste, a deep geological repository for high-level radioactive waste and a combined repository for low, intermediate and high level waste [55].

The regional multipliers for the combined facility are seen as the most relevant to the current study of the GDF in the UK and are presented in Table B2. The population of the regions considered is close to the median UK district population of approximately 120,000 inhabitants. No national level multipliers are provided in this study.

At the 'regional' level, as defined in the BFE study, a 10% absorption rate[26] of indirect effects is provided for all regions. This is equivalent to a Type I GVA[27] multiplier of 1.1. The rate for the Jura-Ost region is slightly higher as it combines a higher population and employment level and has higher industrial GVA in the baseline.

The Type II GVA multipliers are very similar for the three regions. Once again, the slightly higher figure for Jura-Ost results from the higher population and employment.

Table B2 Summary of regional multipliers for the combined repository in Switzerland

Region	Jura Ost	Nördlich Lägern	Zürich Nordost
Population, '000	133	134	103
FTE employed per 100 inhabitants	40	26	40
Type I GVA multiplier	1.11	1.10	1.10
Type II GVA multiplier	1.35	1.34	1.34

B2.1.3 US DOE - 2008

A study for proposed geological disposal at Yucca Mountain, Nevada, US breaks down the project phases into Construction, Construction and operation, Operation, and Closure. The study suggests that the GDP of the Nye County region would increase by $87 million USD during the construction phase. During subsequent phases the economic growth effect is expected to continue to increase as indirect and induced effects create additional income. The total economic development effect peaks at an added $275 million USD per year to the Nye Country region's economy.

To place this in context, Nye County has a baseline population of 40,000 inhabitants (less than half the population of an average UK district).

Based on the information provided in the study, it is not possible to derive the multipliers used to estimate the additional income through indirect and induced expenditure.

B2.2 UK Multiplier Data

B2.2.1 National level

The UK Input-Output tables published by the ONS [56] provide the national output multipliers for the mining and construction sectors for 2005 as given in Table B3:

Table B3 UK National multipliers for the construction and mining sectors

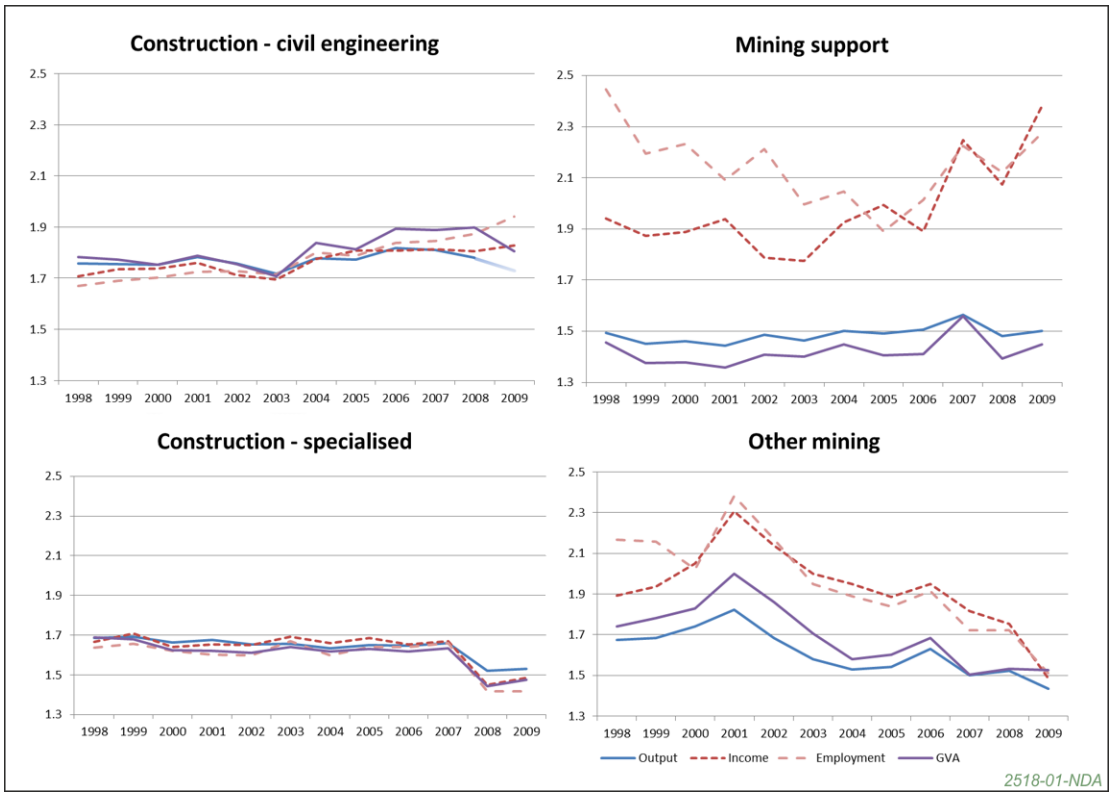
Sector	Type I Output multiplier
Construction	2.141
Metal ores extraction, other mining and quarrying	1.992

[26] Absorption is defined as the total value of the effect minus displacement and leakage.

[27] Gross value added (GVA) is a measure of the relative value of goods and services produced in an area, industry or sector of an economy. At a micro-level, GVA is the contribution of each individual producer, industry or sector to the economy. At an aggregate macro-level it provides a summary measure of the complex interactions of the economy.

These national multipliers are applied in this analysis as the medium scenario (as included in Table B4); however, it is important to note that multipliers can change over time. Figure B2 provides an illustration of how Scottish multipliers for two types of construction and mining sub-sectors have changed; showing that on average, the multipliers for these sectors varied by 20% over a ten year period.

Figure B2 Illustration of changes over time of Scottish construction and mining multipliers



Although a significant change in multipliers is unlikely in the short to medium term, over the duration of the project national Type I multipliers might be expected to increase by up to 20% (resulting in multipliers that approach the highest figure for any sector in 2005 at 2.62) or decrease by up to 30% (resulting in a figure closer to the Type I multipliers for the Canadian construction and mining sectors). These changes would be associated with a reduction/increase in the proportion of imports to the sectors supplying the construction and mining sectors, among other things.

Type II multipliers, that is, composite indirect and induced effect multipliers are not published by the ONS for the UK as a whole but are available at the regional and neighbourhood level. In order to determine the range of the ratios of $\frac{Type\ II}{Type\ I}$ multipliers to apply to the GDF project, relevant Canadian, Swiss and Scottish weighted multiplier ratios were identified as 1.2, 1.35 and 1.5 respectively[28]. To apply these in the analysis, the numbers were then multiplied by the respective Type I UK multiplier estimate (that is, low Type I multiplier scenario multiplied by low Type II to Type I ratio) to produce low, medium and high Type II multiplier scenarios for the GDF project, as shown in Table B4.

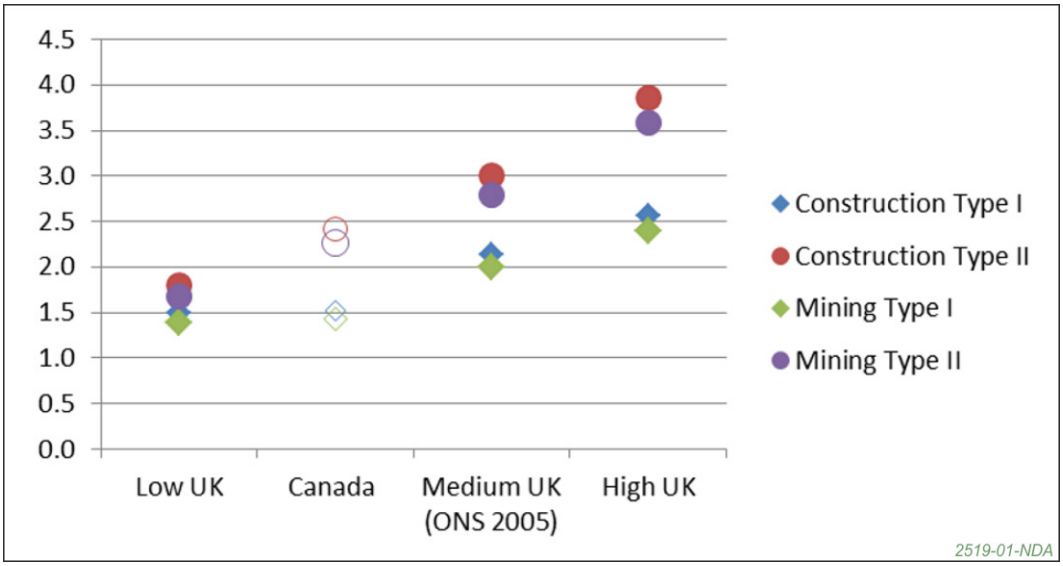
[28] On basis of AECOM 2011, BFE 2012 and Scottish Government 2013a and 2013b, with a higher weight given to the national datapoints from Canada as compared to the regional datapoints from Scotland and Switzerland.

Table B4 UK derived multipliers

Sector	Low	Medium	High
Type I			
Construction	1.50	2.14	2.57
Mining	1.39	1.99	2.39
Type II			
Construction	1.80	2.89	3.85
Mining	1.67	2.69	3.59

Figure B3 below shows how these figures compare to the Canadian multipliers for the construction and mining sectors:

Figure B3 National level multiplier ranges



B2.2.2 Regional and district level

In order to define regional and district level multipliers, the Green Book suggests the use of non-sector specific composite (Type II) multipliers presented in the Homes and Communities Agency's Additionality Guide. The neighbourhood size used to derive the Homes and Communities Agency Multipliers is smaller than the size of a typical district. Therefore, the district multipliers presented in Table B5 represent the average between neighbourhood and regional multipliers.

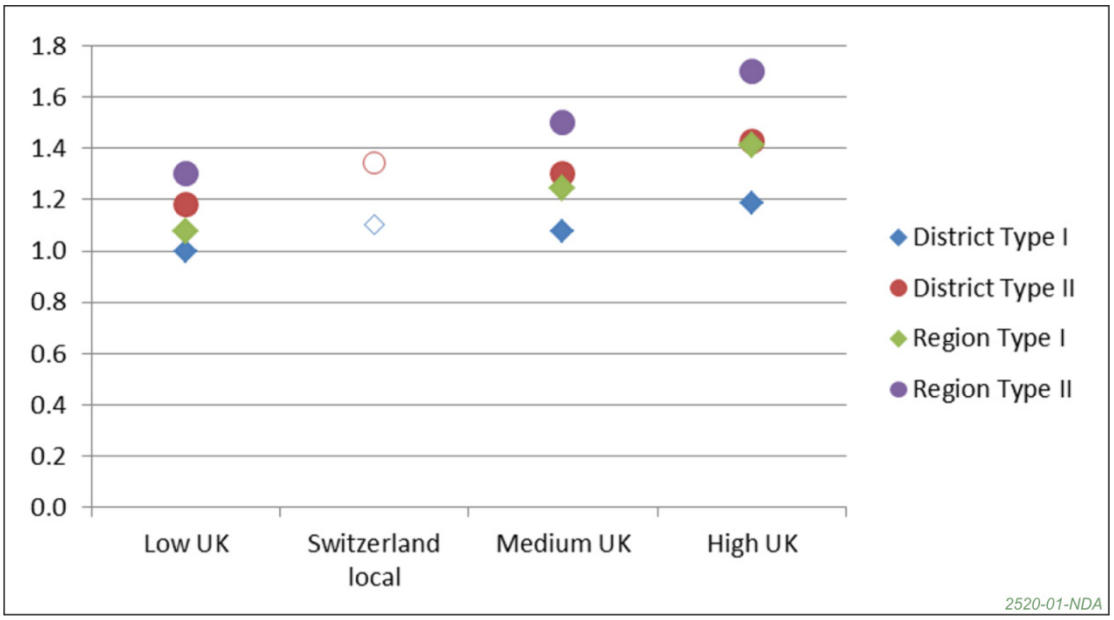
Table B5 Type II district level multipliers

District Level	Neighbourhood	District[29]	Region
Low (limited local supply linkages)	1.05	1.18	1.3
Medium (average linkages)	1.1	1.30	1.5
High (strong local supply linkages)	1.15	1.43	1.7
Low (limited local supply linkages)	1.05	1.18	1.3

The district multiplier derived above is in the same range as the Type II multipliers used in the Swiss study.

As previously explained, Type I multipliers at the district and regional level are not published in the UK. To derive these, a multiplication factor of 0.83[30] was assigned to Type II multipliers as defined above. The resulting regional and district multipliers are presented in Figure B4.

Figure B4 Regional and district multiplier ranges



29 These have been averaged from neighbourhood and region estimates.

30 This adjustment is robust as it uses numerous data point from Scotland and Switzerland, but causes inconsistency when the value of the district multiplier is lower than $\frac{1}{0.83}$ and produces negative indirect effect estimates. In this case, a less robust estimate based on the proportion of indirect versus total induced and indirect effects (0.31) from the Swiss case study (BFE 2012) was used instead.

B2.3 Further assumptions

B2.3.1 Direct spending

Assumptions used here relating to the cost and duration of the GDF project are based on RWM's latest (2016) generic designs. The design of the facility (and its associated cost) is sensitive to a wide range of issues and, in particular, to the nature and volume of the inventory for disposal, the host rock in which the underground facilities are constructed, and the assumed timetable for implementation. Because of the relatively high degree of uncertainty at the current, generic stage of RWM's work, the costs of implementing geological disposal are presented here as a range which should be regarded as purely indicative. Direct cost assumptions have been adjusted to reflect the proportion of imports from outside the UK, which are assumed to constitute around 22.5% of total project costs[31]. Table B6 shows the resulting direct spend figures at the national level which were applied. These cost estimates cover a range across the different types of geology.

Table B6 Direct spending assumptions (£million)

Project Phase	Range Total assumed spend per phase (£ million)
Siting process	1,400
Construction to first waste emplacement	2,500 – 3,000
Construction and operation	15,300 – 24,200
Closure	900 – 1,000
Total	**20,100 – 29,600**

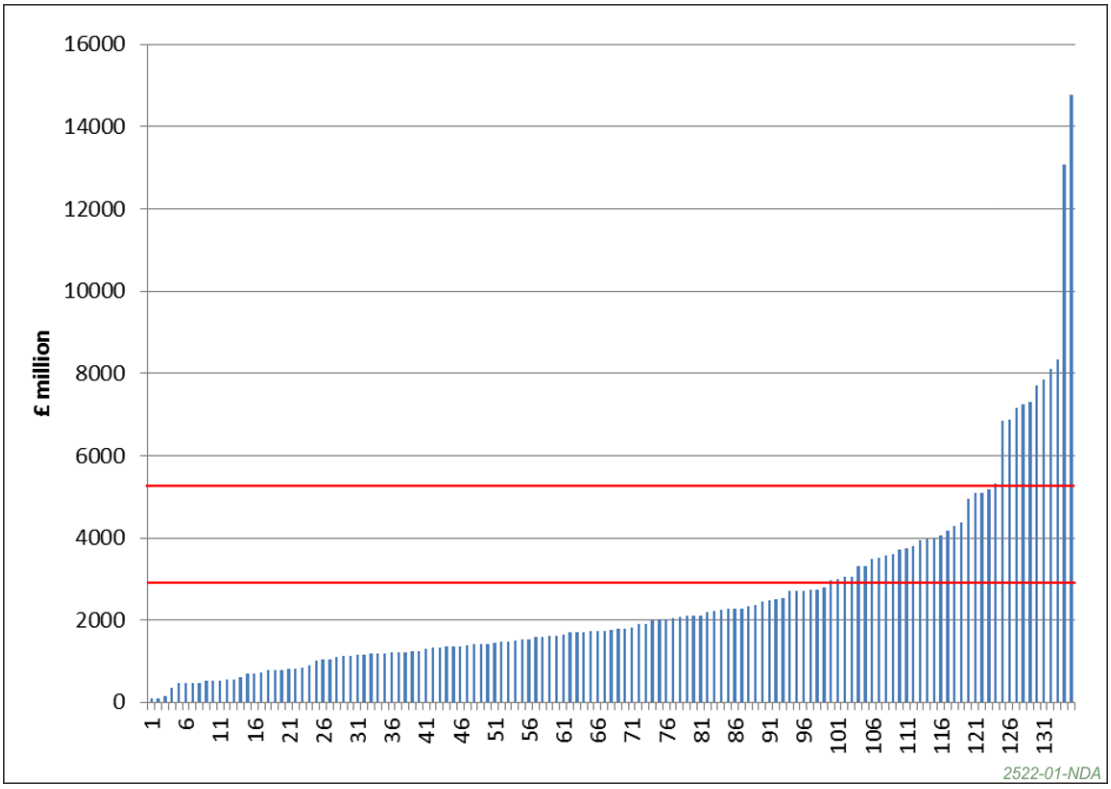
B2.3.2 Regional and district characteristics

As previously explained, the multiplier effects associated with direct spending vary due to factors such as 'economic linkage', that is, the degree to which a local economy can provide the goods and services a project needs. A host district for the GDF will incur low, medium or high indirect multiplier effects based on the level of activity in the production (including manufacturing) and distribution, transport, accommodation and food sectors – as these are the sectors most likely to supply goods and services associated with expenditure and employment at the facility.

Inflation adjusted district and regional GVA statistics for 2006-2010 were used to determine low, medium and high activity or linkage levels. This was done by removing outliers and summing the GVA for the production, distribution, transport, accommodation and food sectors in each district. The totals were split equally into three ranges to define the threshold for low, medium, and high level linkages. The proportion of districts falling into each range fed into the estimation of the expected outcome for a non-specified UK district (see Figure B5 below).

[31] This assumes that the total project spending will be distributed as follows: 75% on goods and 25% on services and employment. Of the goods procured, 30% are expected to be imported, resulting in an overall import proportion of 22.5% of project costs.

Figure B5 Number of UK districts with high, medium, and low linkages



As shown, most districts (73%) fall into the low linkages category, as there are a larger number of districts with relatively low levels of GVA in the selected sectors. Of the remaining districts, 19% are considered 'medium linkages' and 8% as 'high linkages'.

At the regional level, high supply linkages are assumed to imply a high level of activity in the Production sector only. Construction sector statistics are not included as most of the supplies to the GDF will be in the form of outputs from the production sector, such as construction materials and electric motors. The distribution, transport, accommodation and food sector is not included as only small number employees at the GDF are expected to commute from the wider region due to the associated time and financial costs.

Average inflation adjusted data for 2006-2010 were used to categorise UK regions, using the same approach as above for the district level. This results in 3 regions being categorised as 'low linkage', 6 as 'medium linkage' and 3 as 'high linkage'.

B3 Results

Indirect and induced effects are estimated at the district, regional and national levels. The figures below (Figure B6 and Figure B7) present the results as total undiscounted effects and average annual effects. For illustrative purposes, these are based on a composite of project spend across the HSR, LSSR and EVR geological categories.

In deriving the results, multiplier assumptions were applied to direct spend to create high, medium and low ranges at the national level. At the district and regional levels, the 'expected value' point (featured as a green square) is the weighted average of the low, medium, and high impacts multiplied by the proportion of regions or districts in each category. This follows the concept of using historic frequency to predict future probabilities by multiplying each outcome value by its estimated probability and summing them.

At the national level, the green square corresponds to the results from the 2005 ONS Type I multipliers for the UK adjusted by the average estimate to obtain Type II multipliers. The blue line provides the estimated upper and lower bounds of the results.

Figure B6 Undiscounted spend over the lifetime of the project

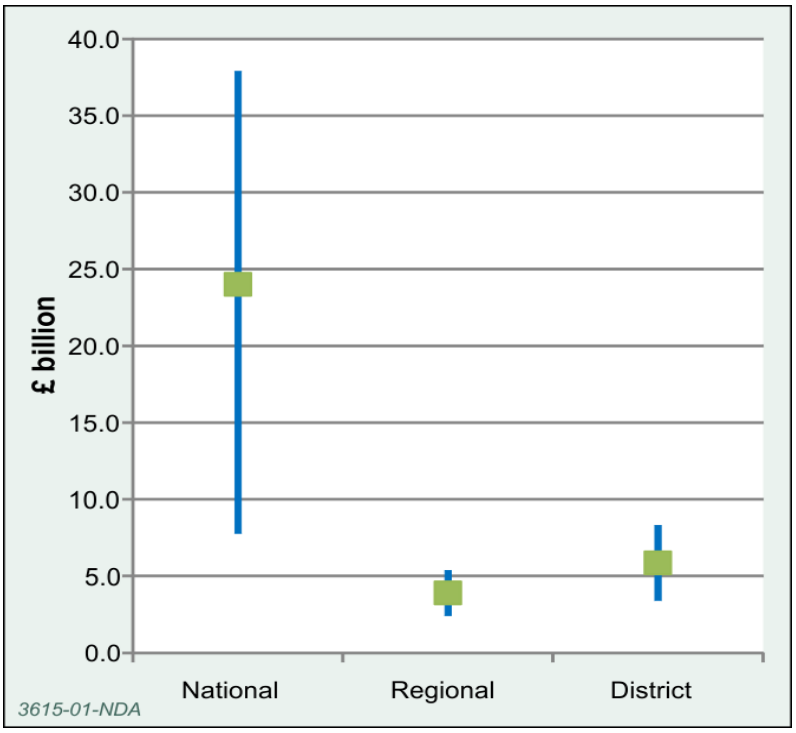
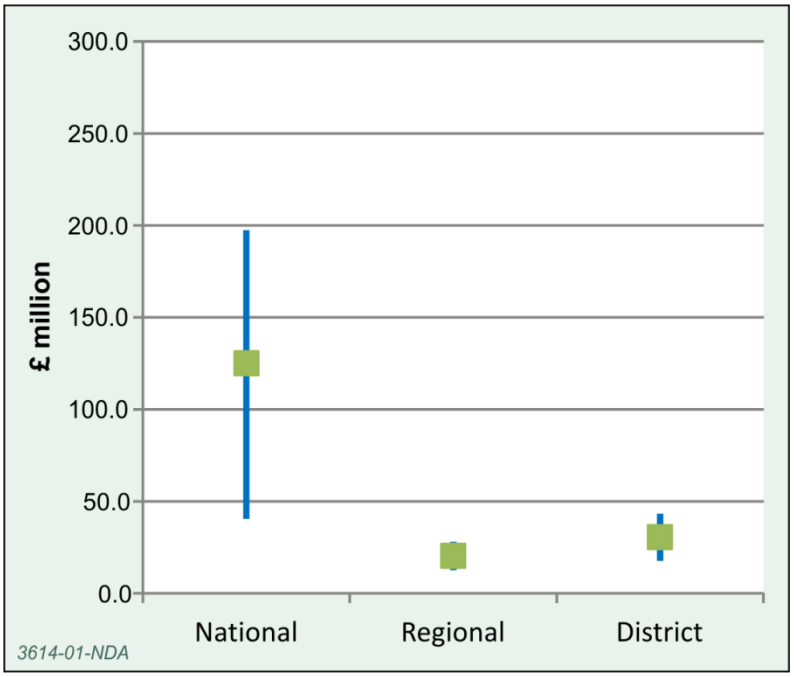


Figure B7 Average annual (undiscounted) spend



B4 Conclusions

The objective of this analysis is to provide a broad understanding of the potential economic development impacts which may result from the development of the GDF. However, given

that it is a generic level analysis rather than a geographically specific one, there is a degree of uncertainty with respect to the results. During the siting process for the GDF, site-specific analyses can be undertaken to refine the assumptions applied and increase the level of precision expected in the results.

B4.1 District effects

At the district level, undiscounted economic development benefits are expected to range between £3.4 billion and £8.3 billion over the lifetime of the project. The lower end of the range is considered to be more likely due to the fact that only a small proportion of districts have high supply linkages with the GDF.

The average (weighted on basis of the number of years in a project phase) undiscounted annual benefit is expected to range between £18 million and £43 million.

B4.2 Regional effects

At the wider regional level, once the district effects are subtracted, the undiscounted economic development benefits are expected to range between £2.4 billion and £5.4 billion over the lifetime of the project.

The average (weighted on basis of the number of years in a project phase) undiscounted annual benefit is expected to range between £13 and £28 million.

B4.3 National effects

At the national level, once the regional effects are subtracted, the undiscounted economic development benefits are expected to range between £7.8 billion and £37.9 billion over the lifetime of the project.

The average (weighted on basis of the number of years in a project phase) undiscounted annual benefit is expected to range between £41 and £197 million.

B4.4 Total effects

The total added present value (undiscounted) benefit to the economy as a result of the GDF project is estimated to range from £13.6 billion to £51.6 billion, as shown in Table B7.

Table B7 Total undiscounted economic effect (£ million)

Location	Lower	Likely UK median	Higher
District	3,418	4,268	8,300
Regional	2,441	5,497	5,371
National	7,785	24,020	37,886
Total	**13,644**	**33,785**	**51,557**

B4.5 Key certainties

The following potential drivers may be expected to alter the results as presented here.

- Effects at the district and regional level could be much higher, depending on the strength of the linkages between the project and the sectors present/active. The construction and mining sectors have high multiplier effects at the national level, therefore higher indirect effects are expected than the ones presented in this analysis, where non-sector specific multipliers from the guidance documents are used. In addition, even if the selected district and region for siting the GDF do not

have strong linkages initially, the duration of the project is such that these could be developed over time.

- Without location specific modelling, it is not possible at this stage of the assessment to determine the level of displacement[32] that the new economic activity from the GDF will stimulate. For example, construction companies in the area might end up supplying the GDF instead of existing customers, who then source products and services from outside the area. The exclusion of displacement assumptions in this case might have resulted in overall impacts being over-estimated.

[32] In this context displacement would entail increasing the activity of local businesses to supply the GDF by decreasing other activities of these enterprises and causing a reduction in exports from the area and/or an increase in imports of non-GDF related products.

Appendix C – Tourism

C1 Introduction

This Appendix considers potential tourism effects from the GDF based on four geographically distinct area types and two tourism scenarios. Both business and leisure tourism effects are considered.

C2 Effects on Leisure Tourism

C2.1 Approach

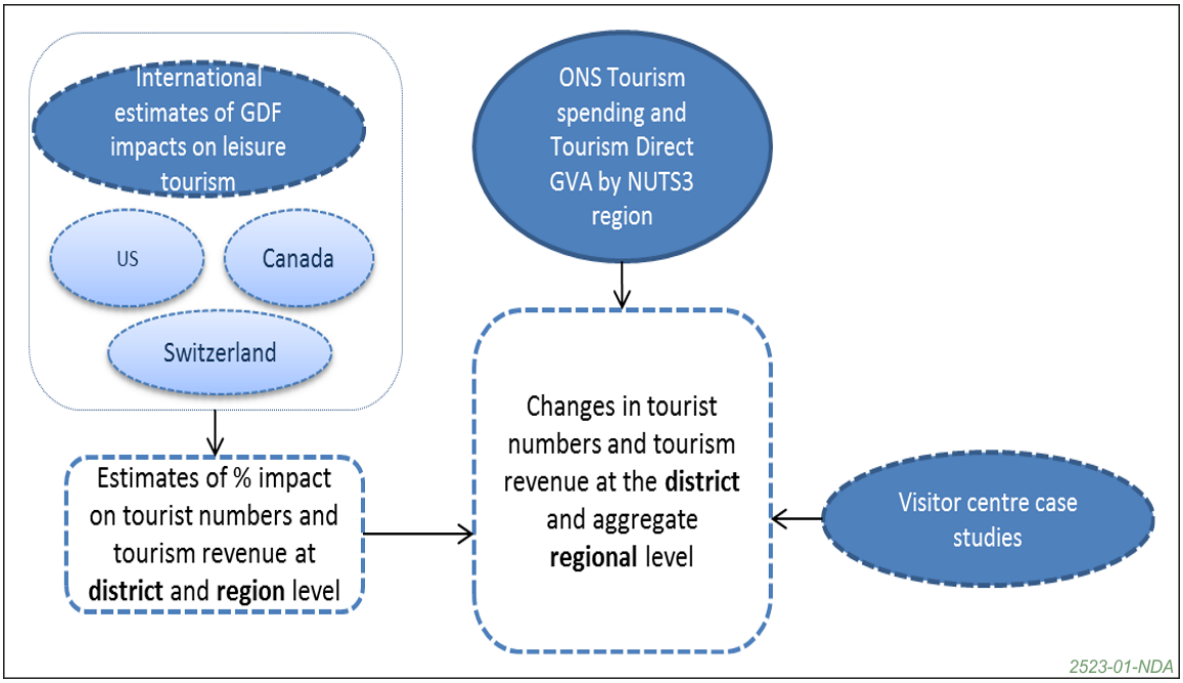
This analysis draws on three international case studies for proposed geological disposal facilities in Canada, the US and Switzerland.

'High' and 'low' scenarios have been considered, with ONS Tourism Spending and Tourism Direct GVA figures for 2011 (at the NUTS3 level - a geographic delineation required for EU statistical reporting) being used as the basis for the analysis. Four types of areas were modelled: urban inland, urban coastal, rural inland, and rural coastal. Results have been scaled from the NUTS3 level to more geographically appropriate units.

The approach only considers the presence of the GDF and does not include consideration of any possible effects the transport of radioactive waste might have on tourist numbers and spending.

Based on the methods used in the case studies reviewed and UK-based data on tourism spending sourced from ONS and Visit England, a simple model of the effects on leisure tourism on UK communities was developed. This approach is illustrated in Figure C1.

Figure C1 Approach to modelling effects on leisure tourism



C2.2 AECOM 2011 – Canada [57]

In 2011 AECOM carried out a socio-economic study for Ontario Power Generation's proposed Deep Geologic Repository in Bruce County.

Bruce County has a resident population of approximately 65,000, but in 2008 it attracted over 1.2 million visitors from Canada, the United States, and overseas. These visitors spent over 145.5 million Canadian dollars (approximately £74.3 million[33]) in Bruce County on tourism-related expenditure. Overall, the local tourism industry directly employs one in seven people.

Statistics for each Province indicate that from 2001 there has been a significant increase in visitor numbers to the two main tourist attractions: Inverhuron Provincial Park and MacGregor Point Provincial Park. This is despite the nearby location of the Bruce nuclear power station. The study therefore concludes that, *"no adverse effects on Provincial parks or the tourism industry as a whole are expected during the Deep Geological Repository Project"* [57, p. 223]. It is worth noting that the study only considered the potential effects on tourism from the repository itself, and did not include any potential effects resulting from the transportation of radioactive waste through the surrounding area to the repository.

C2.3 US Studies

In the United States, Yucca Mountain in Nye County, Nevada was chosen as the preferred site for a deep geological repository for spent fuel. However, the project was effectively stopped by the withdrawal of federal funding in 2010.

Nye County is the third largest county in the lower United States in terms of area, but has a population of only around 45,000. Within Nye County, the town of Pahrump lies close to the site at around 150km to the southeast and is home to most of the county's population with 36,441 inhabitants in 2010. The large city of Las Vegas, a major international tourist destination, lies approximately 225 km to the southeast of the site and Death Valley National Park in California, another major attraction, lies about 80km southwest.

Socio-economic studies conducted by the state of Nevada [58] suggested that negative perceptions of the repository could have a significant effect on the tourist economy, particularly in the event of a radioactive waste accident or incident occurring. It was estimated that the behavioural response in terms of tourism, in-migration and economic development could negatively affect key economic sectors by 5% - 20%. A further study by Gruen and Associates on the effects of the Yucca Mountain site in nearby Inyo County, California estimated that the announcement of the opening of the repository could lead to a drop in visitor numbers of between 17% and 26%. They also suggest that after 10 years of operating accident free, the decline in tourism revenue would reduce to 5% to 15% below the historic average [59].

These U.S. studies considered a large study area, included possible transportation corridor effects, and included potential effects on major international tourist attractions (such as Las Vegas). It is questionable how applicable the study findings are to the situation in the UK; however they do provide useful methodological insights related to effects on leisure tourism.

C2.4 Bundesamt Für Energie (BFE) - Switzerland [60]

The Swiss Federal Office of Energy (Bundesamt Für Energie, BFE) carried out a socio-economic study to investigate a number of potential regions for siting a deep geological repository. The approach to tourism in the study was to divide the types of visitors to the regions into five categories with sensitivity to a facility ranked between 0 (no sensitivity) and

[33] At an assumed exchange rate of 0.5104 GBP per Canadian dollar.

5 (high sensitivity) as shown in Table C1. Business visitors were considered to have the lowest sensitivity and outdoor/sports/wellness visitors the highest sensitivity. The study assumed that tourists will be sensitive to a facility during construction and operation, but not during the siting and closure processes.

Table C1 Swiss Study tourist categories and estimated sensitivity

Visitor categories	Sensitivity
Business visitors	0%
Visitors of historical and architectural attractions	1%
Outdoors, sports and wellness visitors	5%
Visitors for cultural and events purposes	1%
Shopping and gourmet	0%

The Swiss study concluded that leisure tourism revenue in the host region will decrease by between 1.3% - 1.9% as shown in Table C2, with the higher estimate attributed to the Zürich Nordost region which has a high proportion of outdoors, sports and wellness visitors. Additional effects identified included the potential for protests and road closures, which might affect tourist numbers for short periods of time, but with negligible effects for the full duration of the project.

Table C2 Forecast effects on tourism from Swiss study

	Jura Ost	Nördlich Lägern	Zürich Nordost
Existing nuclear plants	KKW Beznau, PSI, Zwibez, Zwilag	None listed	None listed
Loss in overall tourism GVA	-1.6%	-1.3%	-1.9%

C2.5 Impact of a Nuclear Waste Repository Facility on perceptions of West Cumbria [61]

A study undertaken in April 2011 examined the perceptions of a waste facility in West Cumbria. This is instructive as it indicates typical perceptions of how the facility will impact on visitor numbers and tourism.

A key finding from the survey work was that whilst over half of all visitors could see no possible impact on tourism, 40% felt that the GDF would negatively impact on the number of tourists. 36% of respondents perceived that spending would decrease whilst general views focussed on the ‘negative publicity’ associated with the nuclear industry and the fear that potential first-time visitors could choose another destination. A third of those surveyed felt that the ‘cultural heritage’ of Cumbria would be adversely affected.

The overall conclusions from the work were that there is general concern amongst visitors, businesses operating in the tourism industry and wider stakeholder organisations in relation to the GDF. When asked about the single main advantage of the GDF, 48% of tourists referred to employment creation and the benefits to the economy. The stated ‘largest’ concerns included the impact on the environment (24%), health risks (23%) and the impact on the tourism industry (19%).

Although the overall view of visitors (and those that work with and represent them) is more negative to those of residents, the strength of this perception is driven by:

- the choice of a location for the GDF and the relationship between the location and core visitor areas
- the influence of the media and the way that communication processes cover a) how the GDF is managed and 2) how the local tourism 'brand' is protected
- the strength of partnership working and engagement with key stakeholders and representative groups

C2.6 UK Data

Baseline visitor spending data

The ONS Tourism Spending and Tourism Direct Gross Value Added (TDGVA[34]) figures for 2011 were used as the basis for this analysis, which are available at the NUTS3 level[35]. The proportional relationship between tourism spending and TDGVA figures is constant through all the regions. Therefore, spending statistics can be used to directly project the impacts on TDGVA.

To develop the baseline, a growth rate of 3% is used for the project period. This rate sits between the 3.8% spending growth projection until 2025 published by Visit Britain [62] and consideration of the long-term productivity growth projections of 2% for all sectors of the economy used by the HMT in long term impact assessment.

Tourist activity surveys

Data from the International Passenger Survey 2011 [63] was reviewed, which is a survey of international tourists visiting the UK, as well as the Great Britain Tourist Survey. The International Passenger Survey data provides information about the types of activities that tourists participate in. These include the categories in Table C3 below.

[34] The value of all revenue that is directly attributable to tourism.

[35] NUTS3 is a geographic delineation required by EU statistical reporting and comprises areas that are generally larger than UK districts.

Table C3 International Passenger Survey: data adjustment

International Passenger Survey tourist activity category	Average tourist weight estimate[36]
Visited museums or art galleries	27%
Went to theatre / musical / opera / ballet	9%
Visited castles or historic houses	29%
Visited religious buildings	22%
Visited parks or gardens	36%
Went to countryside or villages	18%
Went to the coast or beaches	12%
Went shopping	58%
Went to the pub	46%
Went to bars or nightclubs	13%
Attended a festival (for example, music, food, arts, film)	3%
Went to a live sport event (for example, at a stadium)	3%
Took part in sports activities	2%

The Great Britain Tourism Survey (GBTS) breaks down tourism visits according to the following location types: seaside, countryside and villages, small towns or large towns and cities. The results revealed that 40% of tourism spending occurs during visits to the seaside or the countryside / villages, with the remainder of the spend occurring at the large city or town level.

Due to the differences in data provided by the two surveys, they are not used directly in the modelling applied here. However, a number of general observations can be made. For example, international visitors are less likely to visit the seaside or pursue outdoor activities than domestic tourists. According to Visit Britain, tourism spending in 2013 was forecast to reach £113 billion, of which £24bn was expected to come from spending by international visitors on visits to the UK and fares paid to UK carriers [62]. The remaining £89 billion was forecast to come from spending by domestic tourists. As domestic tourists have been found to prefer outdoor activities, and the potential effects of the GDF on leisure tourism are thought to have the largest impact on those engaging in outdoor activities, the effects of the GDF on domestic tourists could be greater than on international tourists.

Leisure tourism scenarios

For this analysis, UK NUTS3 areas were categorised into four groups: rural coastal, rural inland, urban coastal and urban inland. Coastal areas were determined through a GIS study of UK districts. Where a NUTS3 area was comprised of multiple districts, the area was considered coastal if any one of the districts is coastal. The Urban areas were determined as those NUTS3 areas with a population density higher than 300 people per

[36] The survey is designed in a way that allows respondents to select a number of different activities; therefore, the totals are not intended to add up to 100%.

square kilometre. This cut-off point was chosen to conform with European statistical guidance[37] [64].

NUTS3 areas are, on average, much larger than the regions studied in the BFE 2012 study from Switzerland. For this reason the total impact calculated for the NUTS3 regions was scaled in order to account for the difference in the geographic extent between the Swiss regions and the NUTS3 regions. The average area analysed in the Swiss study was 385 km2, while the NUTS3 regions range from 2.9 km^2 to 13,843 km^2. Therefore, study results were scaled from the NUTS 3 level into more geographically appropriate units.

Scenario I

Scenario 1 is based on the BFE 2012 study from Switzerland and was designed as follows:

- a 5% annual tourism income loss estimate was applied to **rural coastal** areas as it is expected that most of the tourists visiting such an area will be outdoor tourists
- a 1% annual tourism income loss estimate was applied to **inland urban** areas as it is expected that this category will attract the least outdoor visitors in the baseline

On the basis of these assumptions, two intermediate loss estimates were derived for the remaining categories, as follows:

- a 3% annual tourism income loss estimate was applied to **rural inland** areas
- a 2% annual tourism income loss estimate was applied to **coastal urban** areas

The 1% and 5% values are based on a Swiss study; the figures for the UK may be different from these. In addition, the NUTS3 areas are reasonably large and therefore may contain both small towns and villages, but are broken down by average population. Thus, this analysis includes an inherent level of uncertainty.

Scenario II

An additional more conservative modelling scenario was also developed. In keeping with the US Studies, this assumed that effects will be 5 times higher during a 'critical period' of up to ten years following initial GDF development. After this period, if no accidents occur, it is assumed that tourism losses will return to levels assumed from the Swiss study and reduce to zero losses during the closure phase. Table C4 shows the loss estimates applied for Scenario II.

Table C4 Scenario II annual loss estimates (%)

Period	Rural		Urban	
	Inland	Coastal	Inland	Coastal
Critical period	15%	25%	5%	10%
Non-critical impact period	3%	5%	1%	2%

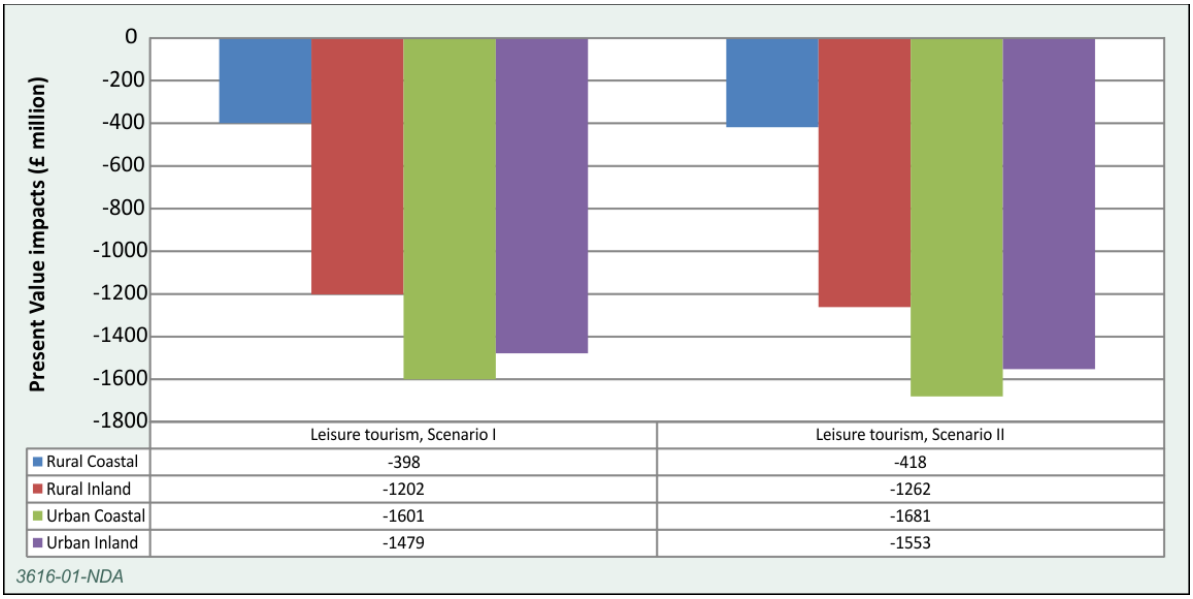
The joint loss percentage for domestic and international tourists during the critical phase ranges from 5% for an inland urban community to 25% for a rural coastal community; this is in line with the lower end of the of US-based tourist reduction estimates.

These loss figures were applied to the TDGVA baseline. For illustration purposes only, a project start of 2014 was assumed. Under this assumption, standard Green Book discount factors[38] are applied from year 2014 to the TDGVA results in each district.

[37] It should be noted that the typology used here does not include an 'intermediate' level, as described in the EU Statistical guidance, which are areas with between 20 % and 50 % rural population.

The results for Scenarios I and II are presented in Figure C2. Under Scenario I, the average annual undiscounted loss to leisure tourism is estimated at £11.4 million, resulting in total undiscounted losses ranging from approximately -£1.6 billion in Urban Coastal areas, to -£398 million in Rural Coastal areas throughout the life of the project. Under Scenario II, incorporating an initial critical period, average annual undiscounted losses would rise to £12 million, generating total undiscounted losses ranging from approximately -£1.7 billion in Urban Coastal areas to -£418 million in Rural Coastal areas throughout the life of the project.

Figure C2 Total undiscounted costs to leisure tourism



	Leisure tourism, Scenario I	Leisure tourism, Scenario II
Rural Coastal	-398	-418
Rural Inland	-1202	-1262
Urban Coastal	-1601	-1681
Urban Inland	-1479	-1553

Visitor Centre Effects

During its operation, the visitor centre at Sellafield had visit counts upwards of 100,000 per year. However, these tourists largely consisted of related business and school educational trips which may not generate the level of spending or overnight stays normally associated with leisure tourism.

The Bruce Power Visitors' Centre in Canada attracted around 12,000 visitors in 2010 and 2011 [65]. According to BFE 2012, it is expected that the visitor centre associated with proposed facility in Switzerland will attract approximately 20,000 visitors per year of which 10% will require overnight accommodation. The visitor centre is expected to bring in approximately £0.9 million (CHF 1.3 million) each year in tourist revenue.

The Andra site at Bure in Meuse/Haute-Marne in France is a proposed site for the disposal of French radioactive waste and already operates a laboratory and a visitor centre, attracting around 11,000 visitors each year [66].

As well as these visitors, the facility also hosts various events and 'open days'. During an open day held in September 2014, for example, over 700 people visited the facility and had an opportunity to talk to the agency's staff. In addition, more than 400 visitors were welcomed to the industrial centre as well as the consolidation, warehousing and storage sites.

[38] For an explanation of discount factors, see Appendix 2 on Economic Development.

Another event was the 'Science Festival' of October 2014 whereby 400 people attended a major event at the facility. 250 school children also attended the event where various activities, including puppet shows, took place.

Both these events at the Andra site indicate the potential to a) boost visitor numbers at a facility whilst b) also encouraging and promoting a greater awareness of operations at the facility. As well as stimulating public interest in the facility, these events can help promote the inherent safety of the facility (an important factor to encourage further visits).

As part of a socio-economic impact analysis of nuclear waste disposal in Switzerland (undertaken in 2005) [67], Rütter and Partners collated evidence on the tourism and visitor impacts at various facilities. These are summarised below:

- **Interim Storage Facility, Würenlingen (Switzerland)**

  On average, approximately 1,650 visitors per annum visit the facility (compared to other facilities, such as the Leibstadt nuclear power plant or the Gösgen facility, this is a low number). The majority of visitors are 'day guests' with a relatively small number being from the local area. Very few (less than 2%) of visitors stay in the region. Overall, annual visitor expenditure in the region is low (approximately £36,000 per annum, or £45,000 per annum if indirect impacts are included).

- **Centre de Stockage de l'Aube (France)**

  Visitors to this facility also travel to other attractions in the region (such as the 'Route de Champagne' in this part of France). This indicates the scope for visitor numbers (and spending) at a facility to be increased if other nearby attractions are also advertised and marketed. From a business tourism perspective, the rebuilding of a nearby hotel was funded as part of the facility construction programme. Occupancy levels at the hotel are high whilst the facility has succeeded in developing tourism in the region based on close links with other attractions, including the Canton de Soulaires Nature Reserve.

- **Interim Storage and Sistiertes Gorleben Repository Project (Germany)**

  This facility generates up to 10,000 leisure visits per year with significant benefits for the local hotel and overnight accommodation sector. Business tourism also generates overnight stays of approximately 50 to 60 per month. To assist tourism in the region, transportation of waste packages is scheduled for the 'off season' (in November, for example) whilst there is no evidence that the repository had had a negative impact on tourism in the region.

- **Repository Project for High-Level Waste, Olkiluoto (Finland)**

  Based on surveys conducted as part of the EIA, the majority of respondents stated that they would prefer not to take holidays near a repository. Despite this finding, the survey results also indicated that it was unlikely that tourism to existing attractions would be adversely affected whilst there was acknowledgement that the facility itself would be an attraction in its own right.

The range of the visitor figures above suggest that a visitor centre could attract between 11,000 and 100,000 visitors per year. The upper range of this estimate is associated with a large number of school trips generating limited spending per visitor. Assuming each visitor spends between £5-10 per visit, the visitor centre is estimated to bring in between £55,000-£1,000,000 per year. These figures would have to be weighed against the costs of building and running the centre, which have not been included in this assessment.

C3 Business Tourism

Only the AECOM 2011 Canadian study [57] mentions business tourism in its assessment among the studies reviewed for this report. The AECOM study brings out the following potential effects in relation to business tourism:

- The 200 temporary workers required during the construction period are likely to compete for accommodation with tourists. This might result in increased business for accommodation providers compared to the baseline, but decreased business for souvenir and gift shops and for rural attractions.
- Non-accommodation tourist spending will be replaced by workers going downtown during weekends, as tourists might be expected to during peak season, and undertake shopping and visiting activities.
- The facility will provide an inflow of corporate overnight stays in hotels and B&Bs at times other than the tourist peak season, therefore supporting the tourist industry in the area. The inflow is not expected to bring sufficient revenue to encourage additional investment in accommodation stock compared to the baseline.
- A survey of tourism accommodation providers across the regional and local study area of Bruce County, Ontario suggested that most operators attribute at least some business to the presence of an existing nuclear power station in the area, with some reporting up to 70% of revenue related to the nuclear power station. The report authors therefore conclude that the presence of the facility will not cause the tourism industry to suffer.

According to the Great Britain Tourist Survey 2011, average spend per overnight stay across the UK is £168, of which £58 is spent on entertainment and non-food shopping. Therefore a figure of £110 per night is used in the business tourism calculations.

Using the NDA's Manpower and Skills analysis [68] as the basis for the employment numbers, it has been assumed that between 20% and 40% of GDF related jobs created will require twelve over-night stays per year (one per month) in relation to visiting the facility. From these assumptions the associated business tourism income at a district level can be derived, as seen in Table C5.

Table C5 Business tourism results

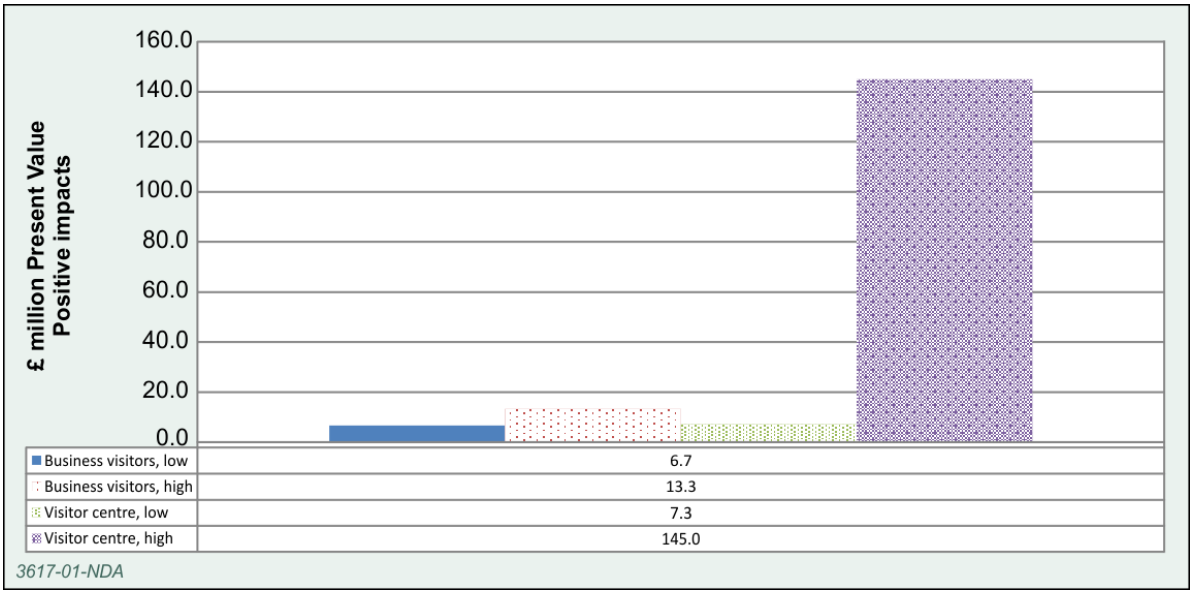
Business travel relevant job creation	Siting process	Construction and underground based investigation	Construction and operation	Closure
Years	15	15	150	10
Off-site jobs	255	250	122	113
20% assumption number of overnight stays	612	600	293	271
40% assumption number of overnight stays	1224	1200	586	542
20% assumption spend (£m)	0.07	0.07	0.03	0.03
40% assumption spend (£m)	0.13	0.13	0.06	0.06

In reality it is likely that during the initial phases, more than twelve overnight stays may be required per relevant employee based off-site, and that fewer visits will occur during the construction and operation phase. In an average year over the course of the project, business tourism benefits are thought to range from £0.04 to £0.08 million, with an undiscounted value for the project lifetime of £6.7 to £145 million.

As well as employee-related visitors, there will also be a number of visitors who will travel to the site when it is operational. These visitors will comprise those making business trips such as engineers, suppliers and other specialists. In the Generic Transport Assessment, it is envisaged that the number of car journeys from visitor activity will be between approximately 10 and 80 per day. Although the majority of these business visits will not entail an overnight stay, there will still be additional benefits (visitor spending on accommodation and subsistence) from those that do stay overnight.

Figure C3 shows the projected undiscounted added tourism spending associated with a visitor centre (see Section C1) and additional business travel.

Figure C3 Undiscounted benefits from business tourism and visitor centre



The effects from indirect and induced employment are not included here; however, it may be the case that some indirect employment may generate additional business tourism as employees in the supply chain may be required to visit the area where their client is located.

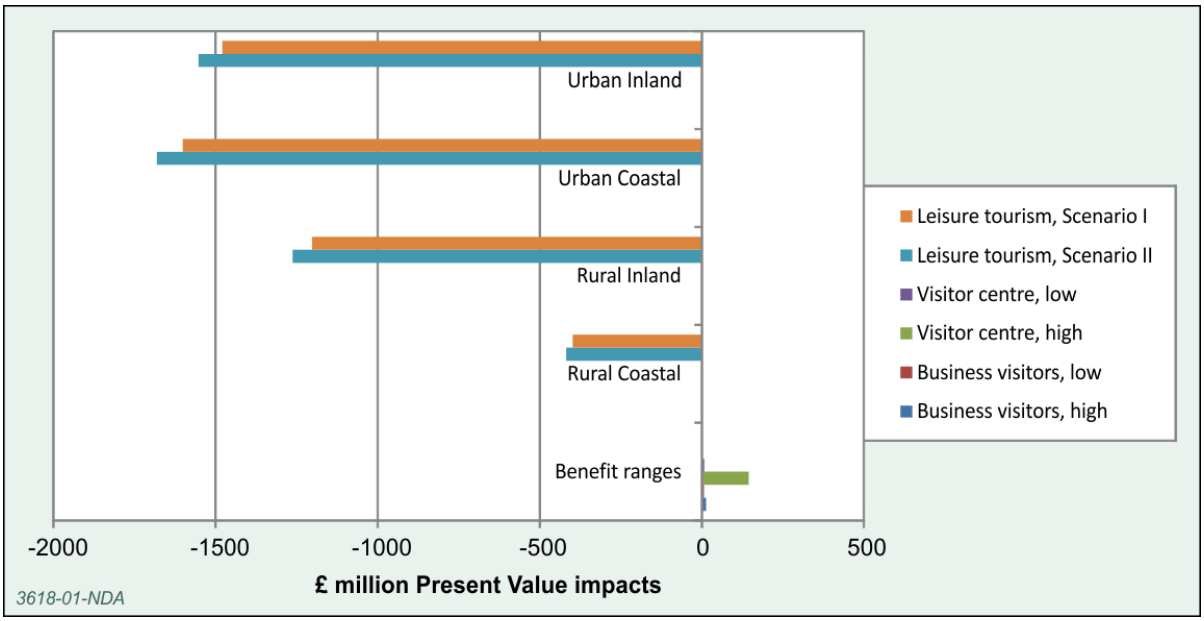
As an illustration, assuming 20% of the indirect jobs created by the GDF will require employees to travel to the site once per month, this could generate an additional £0.14 to £0.27 million in an average year over the course of the project.

C4 Conclusion

This analysis suggests that the GDF may have some adverse effects on leisure tourism in a host community, although from the case study review there is a wide range of opinion on the likely magnitude of effects. The analysis also suggests that there will be some economic benefit from business tourism and from the provision of a visitor centre at the site, which may partially offset any adverse effects on leisure tourism. These results only relate to the GDF facility itself - they do not include consideration of any wider effects that the transport of radioactive waste might have on tourist numbers and spending.

The total lifetime undiscounted results for all effects are presented below in Figure C4. The net effects to the tourism industry over the lifetime of the project are estimated to range from -£1,681 million for an Urban Coastal area in Scenario II, to -£398 million in a Rural Coastal area in Scenario I. On balance, negative effects will probably be higher for urban areas and highest for Urban Coastal areas.

Figure C4 Total undiscounted tourism losses and benefits



C5 Mitigation

The possible adverse effect on leisure tourism could, to some extent, be mitigated by raising the profile of the host community as a tourist destination. It also seems likely, as suggested by Scenario II above that, over time, adverse effects will diminish as the facility becomes a more accepted feature of the area – particularly if there have been no significant accidents or incidents.

An effective public outreach and awareness raising programme as part of GDF implementation could also help to improve the image of a facility and help to minimise adverse effects on leisure tourism. Such a programme could include use of broad range of communication tools to reach a diverse audience including a visitor centre, focus groups, and social media. Several radioactive waste disposal projects in other countries have developed or are proposing such programmes. Some international examples are included below.

Dessel – Belgium [69]

In Dessel, Belgium, a proposal for a Communication Centre has been developed which would be a forum for all nuclear matters including providing information, setting up an ombudsman service, library service, and assembling all local services relating to nuclear activities. This would involve the provision of technology to each family in Dessel to enable them to create a citizens' network, retrieve information and submit questions or comments. In addition, to boost tourist activities in the area, a theme park focusing on radioactivity has been proposed.

Japan – NUMO [69]

In Japan, by implementing an interactive activity or visitor tour of nuclear facilities, NUMO will focus on enhancing people's understanding in the area. In order to bring the development to the attention of opinion leaders, boards of trade, and local community–related boards, NUMO will produce in-house magazines 'NUMO-NOTE', for the local community, related billboards, and build up public relations through national and local newspaper articles and actively using the mass media in areas such as local stations.

US – WIPP [69]

In the US, a Carlsbad Environmental Monitoring and Research Centre was established to conduct an environmental monitoring program and two of the responsible agencies have co-located their environmental monitoring staff and activities in the CEMRC facility. In addition, environmental/hazardous material education and training programs were developed at three local colleges.

Sellafield – UK

About a mile north of Seascale is Sellafield Nuclear Site which is where the world's first commercial nuclear power station was located, with operations ending in 2004. The former Sellafield Visitors Centre was designed as a family and tourist destination to educate the public on the generation of electricity. Its exhibits and presentations were designed to promote insight into the ways that electricity is generated - from nuclear power to fossil fuels. The Centre has now evolved to serve primarily as a Centre for business events.

Appendix D – Profile of the Population Studied

D1 Introduction

This appendix contains district, regional and national level demographic, socio-economic and social service data for England, Wales and Northern Ireland.

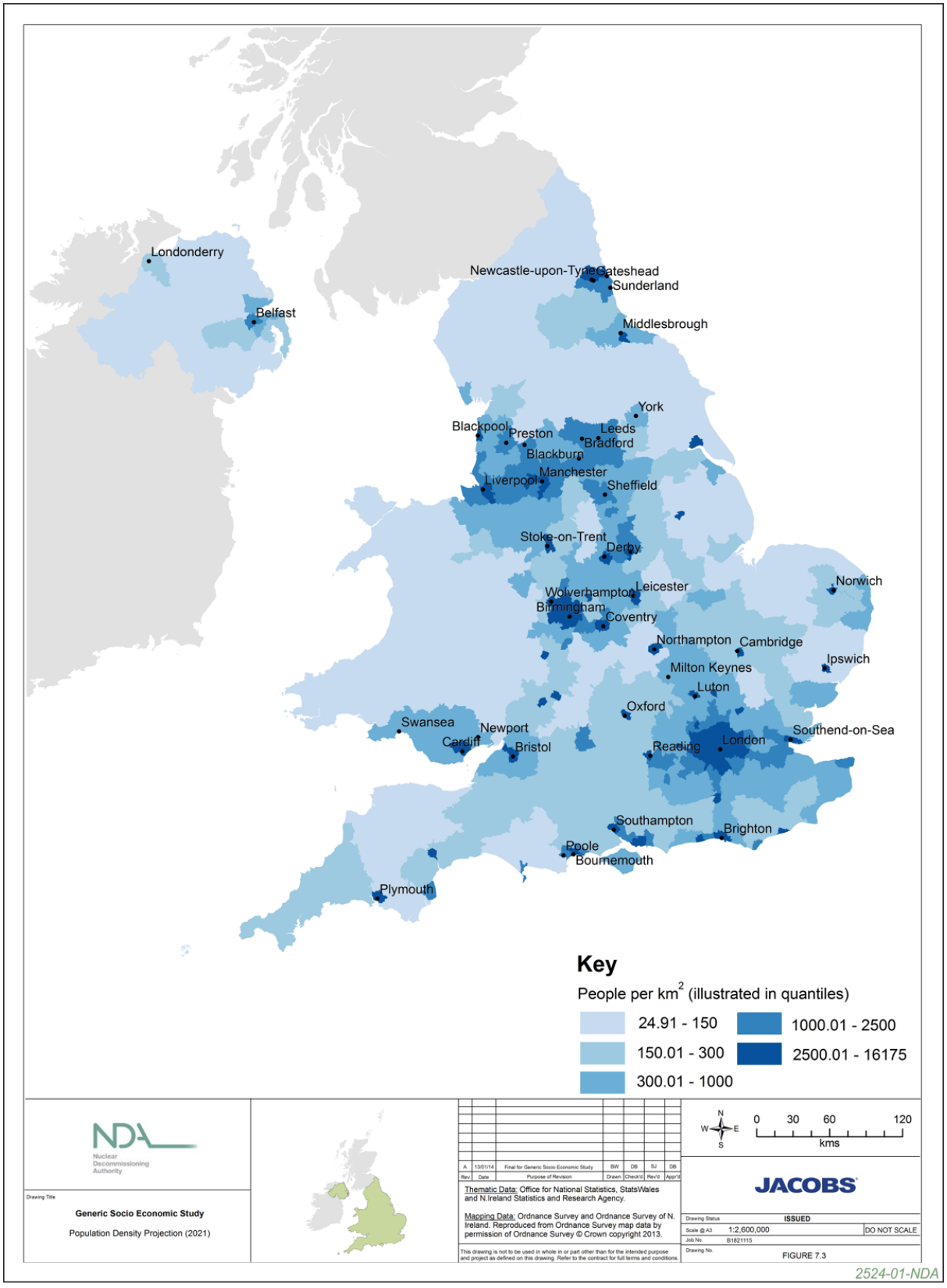
D2 Population and Demographics

The generic Socio-economic Assessment was informed by baseline population information from the UK Office for National Statistics (ONS) on current UK demographics, growth and migration [70]. In certain cases comparable data for England, Northern Ireland, and Wales were not available - any discrepancies have been noted in the relevant sections of the assessment.

D2.1 National population

The 'national' community is defined here as England, Wales and Northern Ireland, but excludes Scotland. The 'national' population was 56,092,000 in 2011. According to the ONS, this population is projected to increase by approximately 7.3 percent by 2021 (see Figure D1) and approximately 20 percent by 2041.

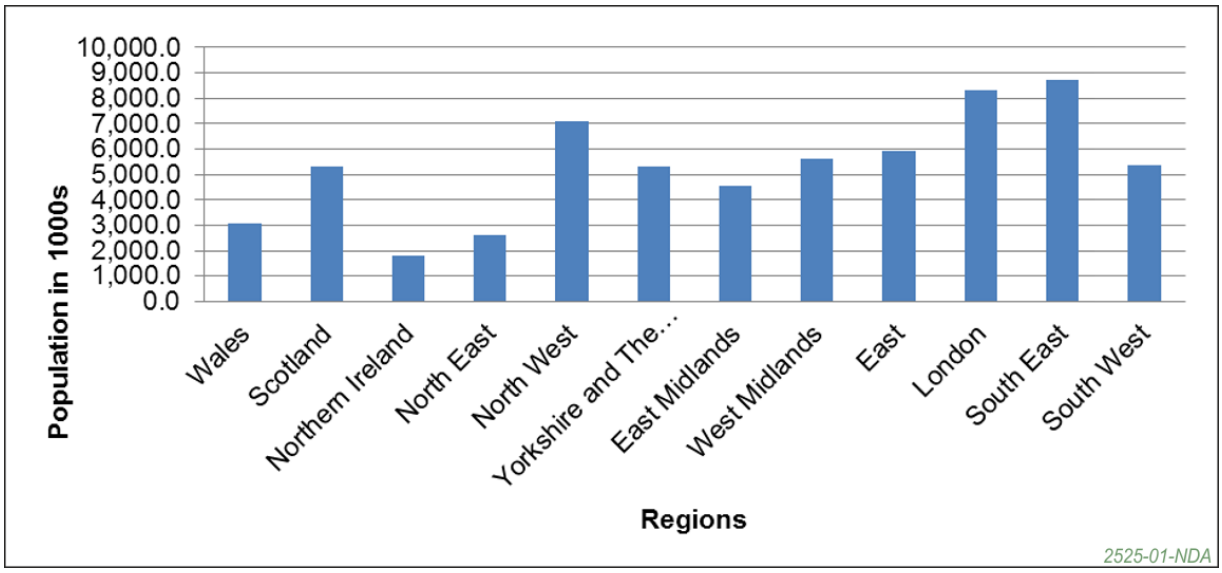
Figure D1 UK projected population density, 2021



D2.2 Regional population

Figure D2 shows the regional population breakdown for the UK. The South East region has the highest overall population. Northern Ireland has the lowest UK regional population and is followed closely by the North East region, which has the lowest population in England.

Figure D2 UK regional population (mid-2012)[39]



Regional population growth

Figure D3 outlines UK regional population growth from 2001 to 2021. Over the next ten years, London and the South East are predicted to show the highest population growth, with growth expected to be highest in urban areas within all regions.

Figure D3 Regional UK population growth projections[39]

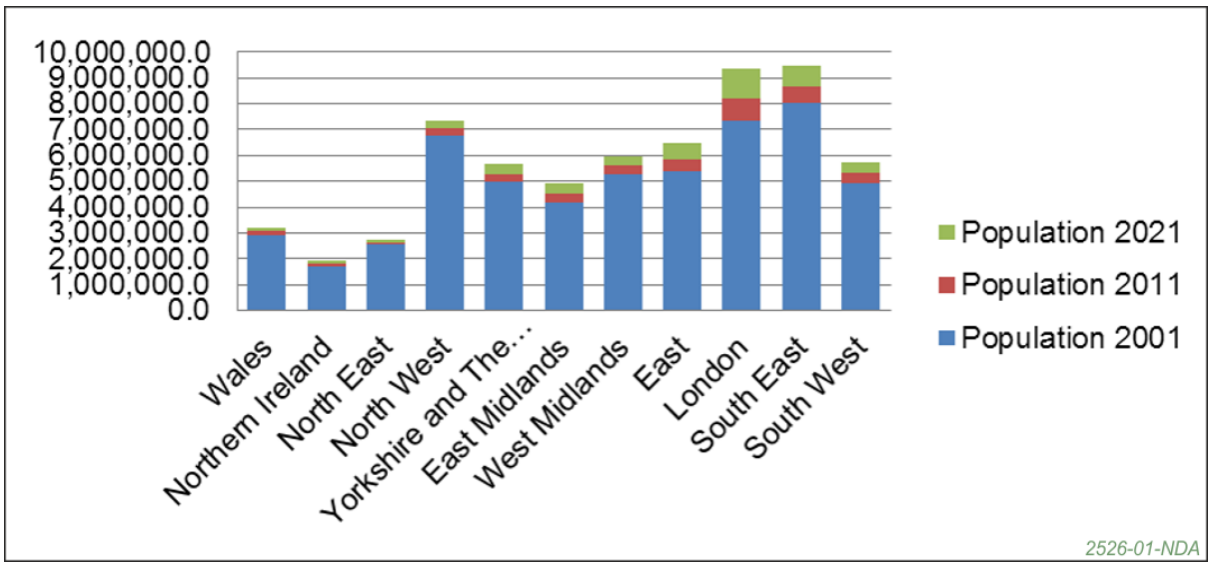
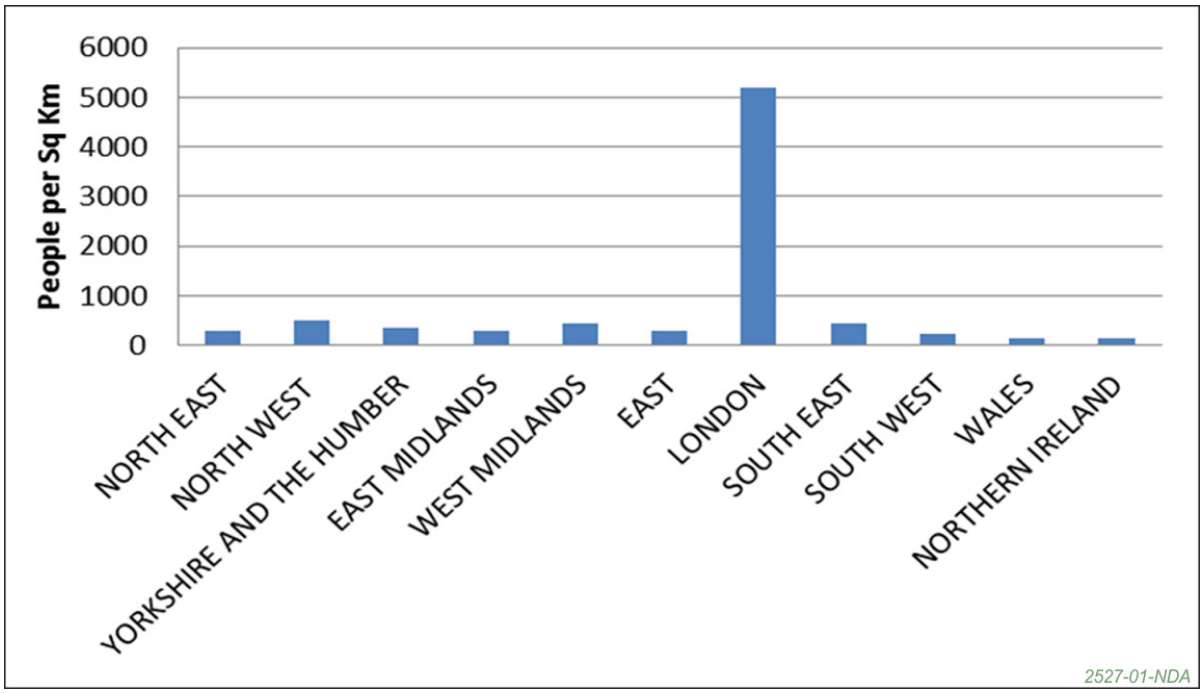


Figure D4 highlights the fact that London is the smallest geographical region with the highest population density, 5,285 people per square kilometre (sq km). After London, the North East

[39] Source: Adapted from Office for National Statistics.

region has the highest population density in the UK, with 502 people per sq km, almost twice the UK average of 263 people per sq km. Northern Ireland has the lowest population density in this study, with134 people per sq km and then Wales has only slightly higher, 148 people per sq km.

Figure D4 Regional UK population density[40]



A summary of population, employment and economic statistics for each region taken from 2012 ONS data, is as follows:

- **North East Region**

  The North East region has the lowest population in England representing 4% of the total UK population, with a 2.6 million population. It has the highest rate of unemployment in the UK at 10.3%. The region produces the second lowest economic output for the UK at 3%.

- **North West Region**

  The North West region is the second largest region in the UK, representing 11% of the total UK population with a 7.1 million population. It has the highest population density in the UK (502 people per square kilometre (sq km) in 2012 (ONS, 2013). 89.4% of the population live in urban areas. The region contributes 9% of the UKs economic output. Unemployment is 8.2% which is just above the national average of 7.8%.

- **Yorkshire and the Humber**

  Yorkshire and the Humber region have a population of 5.3 million, representing 8% of the total population of the UK. Population density is 345 people per sq km, which is above the UK average of 263 people per sq km. The region contributes to 9% of the UKs economic output. Unemployment is 8.9% which is slightly above the UK average of 8.2%.

[40] Source: Adapted from Office for National Statistics.

- **East Midlands**

  The East Midlands represents 7% of the total population of the UK with 4.6 million people. The region contributes to 6.1% of the total economic output of the UK. Unemployment is at 7.8%.

- **East of England**

  The East region makes up 9% of the total UK population with 5.9 million people. Population density is 309 people per square kilometre which is above the UK average of 263 people per sq km. The region contributes to 8.7% of the UKs economic output. Unemployment is 6.5% which is lower than the UK average of 8.2%

- **London**

  London has a population of 8.3 million, representing 13% of the total UK population. It is the fastest growing Region in terms of population. This region generated over a fifth (22%) of the UK's economic output in 2011.

- **South East**

  The South East region represents 14% of the total population of England at 8.7 million. It is the third largest region of England and a fifth of its population live in rural areas. It has the third highest population density of all the regions at 411 people per sq km. The region produces 15% of the UK's total economic output. The South East's unemployment rate was the joint lowest with the South West at 6.0.

- **South West**

  The South West has a population of 5.3 million, 8% of the UK total population. It is the largest English region occupying 18% of the total area of England. Almost a third of the region's population live in rural areas. Population density is 263, the lowest of the English regions but above that of Wales and Northern Ireland. Most of the larger urban settlements are located along the coastline of the region. The region produces 8% of the UK's total economic output. The South West's unemployment rate was the joint lowest with the South East at 6.0%.

- **West Midlands**

  The West Midlands has a population of 5.6 million at mid-2012, almost 9% of the total UK population. Population density was 434 people per sq km. The West Midlands and London are the only landlocked regions. Large areas of the county of Herefordshire and Shropshire are remote and sparsely populated. It has the lowest proportion of its population living in rural areas at 15.1%, compared with the UK average of 17.6%. The region contributed to 7% of the UK's economic output. The unemployment rate in the second quarter of 2013 was one of the highest in the English regions at 9.9%.

- **Wales**

  Wales has a population of 3.1 million, almost 5% of the total UK population. Population density is 148 people per sq km. Two-thirds (67.2%) of people live in urban areas, concentrated mainly in the south east of the country. Life expectancies for the region are slightly lower than the UK averages.

  The region contributed to almost 4% of the UK's economic output. The unemployment rate in the second quarter of 2013 was 8.2%, only slightly higher than the UK average of 7.8%.

- **Northern Ireland**

  Northern Ireland has the lowest UK population, of 1.8 million, making up 3% of the total population. The Belfast metropolitan area dominates in population terms, with over a third of the inhabitants of Northern Ireland. The population density is 134 people per sq km, the second lowest density of all UK countries.

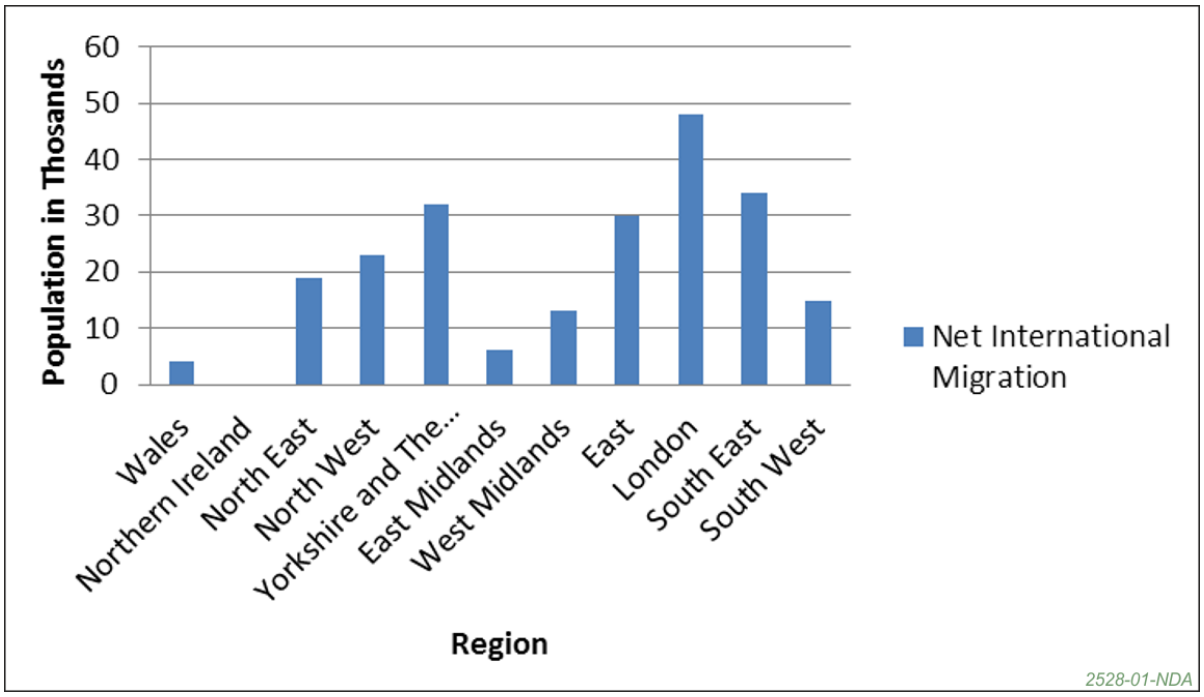
D2.3 District level population

UK Districts typically have populations ranging from 174,000 to 1.1 million. At a District level, an area is considered a low density community or rural if it contains less than 300 persons per square kilometre, while higher density or urban communities consisting of 300 persons or more per square kilometre.

D3 International Migration Patterns [71]

Figure D5 outlines the net international migration into each UK region in 2010. Migration was highest into the London Region (almost 50 thousand), followed by the South East and Yorkshire and the Humber regions respectively. Migration was lowest in Northern Ireland, Wales and the East Midlands.

Figure D5 Net international migration[41]

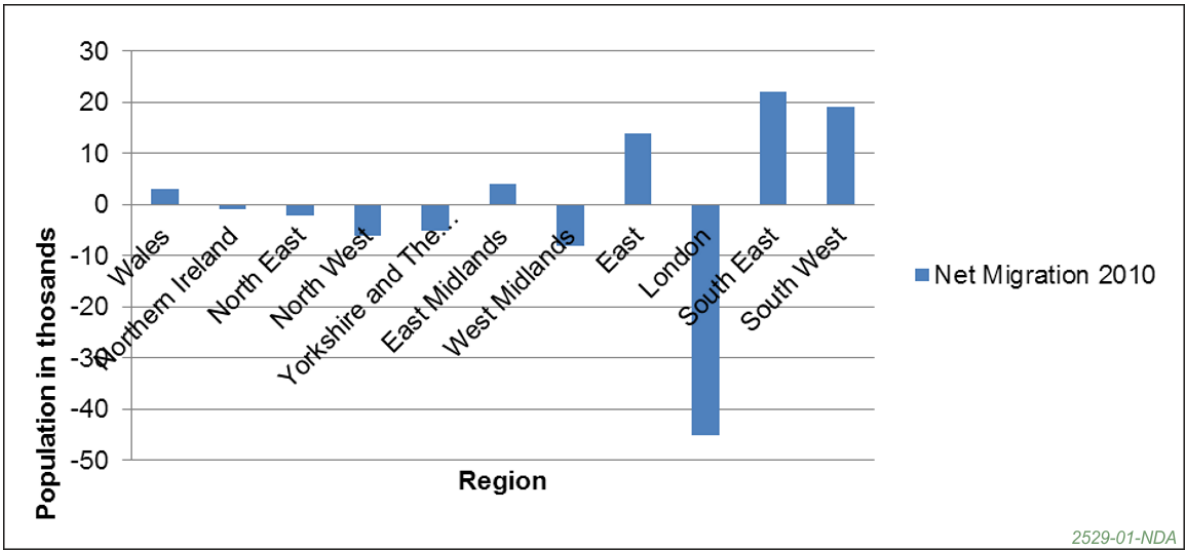


D3.1 Regional migration [72]

There is a lot of movement between regions annually as outlined in Figure D6. Overall net interregional immigration is greatest in the South East, South West and East regions. London has the highest net interregional emigration; however, London has the highest rates of international immigration of all the regions.

[41] Source: Adapted from Office for National Statistics.

Figure D6 Net UK interregional migration[42]



D4 Population Mobility

On a regional basis, population mobility is relatively low. By examining interregional migration patterns and respective regional inflow and outflow data, it can be deduced that approximately 98% of the regional population are non-movers and 2% are movers. Table D1 summarizes relevant statistical data and shows the movers and non-movers in each region in England and Wales. Statistical data on current population mobility is not available for Northern Ireland at this time. London has the highest percentage of UK movers, over 3%. The North East and the North West have the lowest percentage of regional movers (1.7%).

Table D1 Regional mobility - movers and non-movers[42]

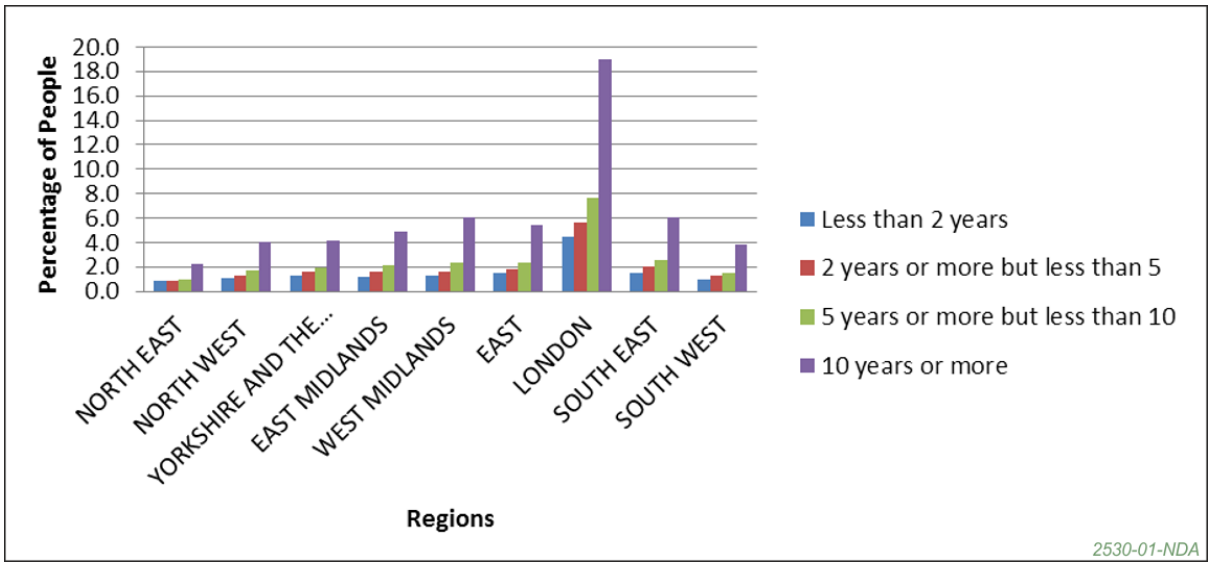
Area	Non Movers	% of No-movers	Movers	% of Movers
North East	2,458,072	98.33	41,676	1.67
North West	6,555,274	98.31	112,714	1.69
Yorkshire and The Humber	4,773,457	97.87	103,753	2.13
East Midlands	3,973,854	97.41	105,777	2.59
West Midlands	5,074,572	97.94	106981	2.06
East	5,131,128	97.58	127,258	2.42
London	6,893,936	96.66	237,912	3.34
South East	7,599,864	97.43	200,190	2.57
South West	4,697,683	97.66	112,371	2.34
Wales	2,802,949	98.18	51,957	1.82

[42] Source: Adapted from Office for National Statistics.

D5 Length of Residency [73]

Information on length of residency in UK regions is presented in Figure D7. According to 2011 Census data, 86% of people born in the UK are still residing there. As shown, most people have been living in their respective regions for 10 years or more.

Figure D7 Length of residency in England and Wales



D6 National Household Composition [74]

There were an estimated 26.4 million households in the UK as of 2013. One person households made up 18% of total households, the highest of all types in the UK. The second highest percentage is married same sex or civil partnerships with children, making up 15%. Married couples without children make up a little more than 12% as do one person households aged 65 or older. According to the ONS, average household size in in England in 2011 was 2.4 and Wales 2.3. The number of households in England is projected to grow to 24.3 million in 2021, an increase of 2.2 million (10 per cent) over 2011, or 221,000 households per year.

In 2010 to 2011, average household size in Northern Ireland was 2.49 persons. Average household size in Northern Ireland has remained broadly at the same level for the last five years. Small households, containing 1 or 2 persons, accounted for 59% of all households. Large households (those containing 5 or more persons) represented 10% of all households. A total of 69% of households consisted of adults only (persons aged 16 and over) and 31% contained at least one child under 16.

Appendix E – Community Benefits Packages

E1 Introduction

This appendix presents a discussion around the types of community benefits packages which have been provided globally related to the development of geological disposal facilities and other large scale infrastructure developments.

Incentive and community benefit packages (also referred to as 'added value') are becoming a common element in many site selection strategies for nuclear waste management facilities (see practices reported in Bergmans, 2010 [75], Kojo & Richardson, 2009 [76], Kojo & Richardson, 2012) [77], Richardson, 2010 [78], Richardson, Wylie & Haraldsen, 2009 [79] and NDA, 2007 [80].

Based on a review of current literature, there are also various international examples of traditional and non-traditional applications of community based agreements for other large scale infrastructure projects. Traditional benefits can include job skill and training programs, affordable housing, infrastructure, recreational facilities, environmental remediation and funds for community programs where as non-traditional benefits can include a whole range of financial and support measures, and can be classified as follows [78]:

- **Cash payments** – for example, lump sums, annual payments, local taxation, trust funds and profit sharing
- **Social measures** – for example, employment, infrastructure, property value protection, integrated projects, relocation of the developer and discounts
- **Community empowerment measures** – for example, capacity building, local partnerships and decision-making

It is possible to recognise two basic approaches to the development of benefit packages, namely:

1. **the 'legally-imposed approach'**

   Here the type of incentives and benefits, their amount and any associated preconditions are mainly determined beforehand in legislation.

2. **the 'locally-negotiated approach'**

   Here the type of incentives and benefits, their amount and any associated preconditions are negotiated between the key players at the local level without a legislative procedure. They are then subject to formal agreement between the negotiating parties.

Irrespective of how the benefit packages are designed, effective agreements have mechanisms for ensuring equitable contributions and increased public participation in their development and implementation. Key steps required for this include: creating a participatory process for community discussions about desired socio-economic outcomes; facilitating an agreement-making process between the project proponent and affected communities; and developing a management and monitoring plan that puts into operation all of the benefits, monitoring and governance arrangements agreed to in the community based agreement as well as plans for dealing with unanticipated issues as they arise. This in turn provides project accountability and helps to develop community acceptance of the project benefits and the trade-offs.

Progressive examples of community-based agreements go beyond mitigating effects and ultimately improve conditions for the community through different types of social investment, as indicated above. The use of simple cash payments is becoming less common, especially

in nuclear facility siting, given that these can often be denounced as 'bribery', especially when communities with low levels of infrastructure are involved.

Development of negotiated community investment packages form a central part of the proposed community support contained within the provisions of the 2014 White Paper in the UK. The exact nature of these will only become clear when one or more potential host communities have been identified in the future and discussions have taken place concerning the long-term vision they have in the new situation.

In the UK community benefits programs have in the past been restricted in their ability to guarantee that a certain proportion of direct spend goes to the local supply chain. However, using this concept, initiatives can be supported that that enable the local supply chain to compete effectively. Some possible applications of the community benefits concept as they could apply to the geological disposal programme are outlined below, based on experiences in other national programmes.

E2 Relevant Case Studies

E2.1 Relevant programmes

Spain - Centralized Storage Facility (CTS) [80]

ENRESA (Empresa Nacional de Residuos Radiactivos, S.A.), was set up by Royal Decree in 1984 to manage radioactive wastes generated in Spain. A centralised spent fuel temporary storage facility (CTS) for spent fuel and HLW is to be developed in the town of Villar de Cañas which will operate until a geological disposal facility is available. Similar to the UK, the siting of the CTS was based on a volunteer approach, ie, communities were asked to express an interest in hosting the facility. For this process, ENRESA took a multi-faceted approach to the provision of community benefits. In addition to the payments available to a community hosting a nuclear facility, it is also proposed to site a Technological alongside the CTS to ensure development of a research and development (R&D) programme with the aim of being a national and European authority on the management of radioactive waste and the environment. To support the CTS installation and the Technological Centre, necessary infrastructure will be put in place in order to gain support from interested companies. The aim is to provide a Business Park comprising companies that are managed by the town council and serve as a support for local business initiatives. The Business Park has been planned so that it can be extended when the need arises with the introduction of different R&D projects, companies and institutions that have shown an interest in the project, including university departments, foundations and major industrial research organisations. It is estimated that a large number of companies of different sizes and levels of experience in the construction, civil works, assembly and installation, manufacturing, transport, supply and technical services, hotel sectors, etc could take part [81].

The money that goes to Municipalities (similar to Districts in the UK) around waste management facilities in Spain comes from the Fund for Nuclear Waste and the amount of payment with regard to each facility was established by a Government Decree from the Ministry of Industry, Tourism and Commerce, involving a formula based upon the amounts of waste handled annually, the type of facility and distance from the Municipality to the facility. The money goes directly to the Municipalities who decide how to use the funds. ENVIROS Spain undertook a study to evaluate what the money provided to Municipalities was generally used for over the last 15 years. The funds from ENRESA have enabled Municipalities to invest in social development projects, such as education and cultural facilities, infrastructure, and basic services.

In some areas, the funds have been used to enhance social welfare through different projects, such as:

- the creation of schools in order to retain children in the villages
- nurseries
- music schools
- sporting facilities

The money has also been used to provide basic services and address priorities for villages, such as:

- lighting and asphalting streets
- urban development projects
- developing green zones

ENRESA also set up a non-profit-making charitable social welfare foundation in 1990 to provide social services which promote and develop social welfare in the Municipalities within the area of influence of ENRESA's facilities. This includes the El Cabril LLW repository.

E2.2 Institutional programmes

USA - WIPP) [80]

The USA has an operational geological disposal facility for transuranic wastes (broadly equivalent to long-lived ILW). The WIPP facility has operated since 1998 and is managed by Nuclear Waste Partnership LLC on behalf of the Department of Energy (DOE). A Cooperation and Consultation Agreement was developed between the Department of Energy (DOE) and the State of New Mexico to formalise the role of the State of New Mexico in the negotiated settlement of key off-site concerns, especially as related to transportation (for example, emergency response, highway upgrading, transportation monitoring, and accident liability). Agreement was reached on funding for necessary road upgrading, ongoing emergency preparedness and emergency response, assistance in conducting baseline health studies of inhabitants in communities near the WIPP site, and post-operation monitoring of the site.

Following an underground equipment fire and an incident involving the rupture of an emplaced waste canister, which resulted in a low level of off-site contamination by radioactive material in February 2014, WIPP operations are currently suspended indefinitely while revised safety procedures and waste management procedures are developed.

In December 2014 the State of New Mexico fined the DOE over $54 million for safety violations. In response, a number of Principles of Agreement were accepted by both parties in May 2015. According to these, the DOE will pay the State $34 million to fund repairs to the roads used to transport waste to WIPP (the so-called WIPP Designated Routes), and pay $12 million to improve roads used around the Los Alamos National Laboratory (LANL) near Albuquerque and $10 million to provide new potable water supplies at LANL. In addition, the DOE will fund external triennial reviews of WIPP's environmental compliance, improve storm-water drainage schemes on relevant roads and provide training and support for 'first-responders' in and around Carlsbad, as well as funding the construction and operation of an off-site emergency operations centre [82].

In the past, the DOE has funded the following social benefit programmes associated with the local community where the WIPP is located.

Carlsbad Environmental Monitoring and Research Centre

The DOE funded the establishment and operation of the CEMRC on the campus of New Mexico State University-Carlsbad. As a unit of the College of Engineering, CEMRC

operates out of a multi-million dollar, 26,000 square foot facility, which has environmental, radiochemistry, and separations laboratories; plutonium-uranium and counting laboratories; an in vivo bioassay facility; and a mobile bioassay laboratory. CEMRC projects include environmental and radiation work, characterization, monitoring, feasibility studies, training and education, nuclear energy, and Homeland Security issues. CEMRC conducts a WIPP environmental monitoring program and WGI has co-located much of its WIPP environmental monitoring staff and activities in the CEMRC facility. CEMRC has partnered with Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL), and Nuclear Waste Partnership, LLC (NWP) to create a unique facility with programs that include: environmental monitoring of almost any radiological and inorganic constituent; actinide chemistry and repository science [83].

Advanced Manufacturing and Innovation Training Centre

The AM&ITC is a large, state-of-the-art training facility and business incubator. The DOE provided the majority of funding for construction of the AM&ITC, which is owned and operated by the Carlsbad Department of Development. Since its opening, the AM&ITC has been used to conduct technical and academic training and education and business incubation, as well as for office space.

Environmental/hazardous materials education and training programs

The DOE and WGI, the previous facility operator, helped establish environmental/hazardous material education and training programs at three local colleges:

- bachelors degree in environmental management program at College of the Southwest-WGI provided funding, curriculum development, instructors, and students
- associates degree in hazardous materials at New Mexico State University-Carlsbad-DOE and WGI helped develop the curriculum and provided instructors and students
- hazmat training program-WGI helped establish the curriculum and provided funding

In addition, WGI recruited a private university to open a branch in Carlsbad, so its employees and other people in Carlsbad would be able to earn business degrees.

Grant writing

With DOE's funding and approval, WGI offered grant writing courses to a host of educational and not-for-profit organisations located in Southeast New Mexico. WGI also helped organisations to write grants, most of which were successful, bringing millions of dollars into the region

School equipment and curricula

DOE, WGI and other WIPP partners donated a large amount of excess computer and office equipment to local public schools. In addition, DOE funded the development and distribution of turn-key science curriculum packages to schools in the region. WGI also donated equipment and money to local schools.

Records centre project

Through WGI, the DOE has funded the establishment of a Centre in Carlsbad designed to archive transuranic waste records not only from WIPP, but also from the DOE transuranic waste generator and storage sites located across the country. This facility will employ approximately 65 people [84].

Centre for hazardous waste management excellence

With DOE funding and support, the City of Carlsbad established a Centre for Hazardous Waste Management Excellence. The Centre serves as a think tank and consultancy for hazardous waste issues.

WIPP acceleration funds

As designated by the U.S. Congress, DOE has been providing Carlsbad with funding to help offset the acceleration of waste disposal (which will result in WIPP completing its legacy waste disposal earlier than originally planned). Carlsbad has used this funding to recruit a medical transcription company to open a facility in Carlsbad, to develop a fire-fighter training Centre in Carlsbad, and to purchase equipment for the city.

Technology Transfer Program

WIPP's Technology Transfer Program transferred (at no cost to the receiving organisation) WIPP-developed organisational tools, training materials, and software to more than 300 organisations in 50 communities throughout New Mexico.

Belgium low-level and short lived ILW [80 and 85]

A partnership approach was put in place in Belgium to develop proposals for facilities for the long-term management of low-level and short lived ILW. This means that the local community is directly involved in developing both the facility design and a socio-economic package for their area. The Partnership process was developed and co-ordinated by the University of Antwerp and University of Liège.

After inviting volunteers from existing communities to participate in the process for siting interim storage and long-term waste management facilities, ONDRAF/NIRAS formed local partnerships with several different communities, Mol and Dessel (both adjacent to the major Mol nuclear site) and the communities of Fleurus and Farciennes, hosts of an isotope manufacturing company. The partnerships enabled members of the public, representatives of local organisations (NGOs, local community groups, socio-cultural and socio-economic organisations), local business representatives and elected officials to take part in the development of technical options and potential community benefit packages. In the event, only Mol and Dessel continued in the process and in June 2006 the Government announced that surface disposal will be the option implemented for the long-term management of low-level and short lived ILW waste and the repository facility will be built on the territory of the Municipality of Dessel. Following submission of a licence application by ONDRAF / NIRAS in January 2013, the facility is expected to start operating some time in 2018 [85].

One of the main functions of the two partnerships associated with this facility was to develop a socio-economic package, in the form of accompanying local projects that seek to bring added value to the community. The goal of the package is to provide tangible social, economic and cultural added value in the short, medium and long term. This consists of several initiatives.

Communication, Contact and Support Centre

A Communication Centre will be developed which could also be used for local community initiatives and become a meeting place for the Dessel population. The Communication Centre will also include a Contact and Support Centre which will be the forum for all nuclear matters including:

- providing information
- setting up an ombudsman service

- library service
- assembling all local services relating to nuclear activities

Digital and interactive network (DIGICAT project)

This will involve the provision of technology to each family in Dessel to enable them to create a citizens' network, retrieve information and submit questions or comments.

Radioactivity theme park

The Dessel area has been involved in nuclear activities for 50 years. Therefore, to boost tourist activities in the area the Dessel STOLA project (Studie- en Overleggroep Laagactief Afval – study and consultation on LLW) have proposed setting up a theme park focusing on radioactivity. It would include interactive animations, scientific shows and workshops. It will be aimed at a broad and diverse public, including schools, families, groups and clubs and companies. It will be able to accommodate around 40,000 visitors per year.

Additional activities

The partnership has also implemented a variety of measures as a result of the programme:

- local health studies
- annual health check-ups, free of charge, for all inhabitants of Dessel
- inclusion of Dessel in future health and environmental research ordered by any governmental body
- changing the status of the village to enable additional small and medium enterprise (SME) zones to be developed, to release existing housing development areas and to create additional building lots
- linking up the south of Dessel with the small-town area of Mol to expand the existing SME zones
- developing the N118 Motorway into an access road for traffic to reduce heavy traffic in the centre of Dessel, for transport to and from the SME zone, the nuclear zone and the disposal facility

Intergenerational fund

As part of the socio-economic package, an inter-generational ‘Local Fund’ (LF) has also been established. The LF will support and finance projects and activities that create sustainable opportunities for the local communities and improve the quality of life of the local population in the short, medium and long term.

The nature of projects and activities financed by the LF may vary: they may have a social, economic or cultural character or be aimed at the environment, health or welfare. The LF thus provides additional opportunities for social, cultural, ecological and economic added values that surpass the added values created by the repository project itself.

Management of the LF will be in the hands of the local partnerships in Dessel and Mol. It will consist of one joint fund with two equal sub-funds. A study for ONDARF/NIRAS showed that a reasonable value for the LF is between 90 and 110 million euros [85].

E2.3 Community grant/loan programmes

Finland SNF [86]

In 1995, Posiva Oy was established as an organisation responsible for the final disposal of spent fuel and research into final disposal and for other expert nuclear waste management tasks. Posiva is owned by TVO (60%) and Fortum Power & Heat Oy (40%), both of which share the cost of nuclear waste management. After extensive negotiations from 1998-2000, the Municipality of Eurajoki and the TVO/Posiva reached several agreements on terms of local compensation for the municipality hosting a repository for spent fuel.

Compensation included partial funding for the restoration of a local manor house, considered to be one of the beautiful empire mansions in Finland and owned by the Municipality, with the additional money being contributed by the Municipality and European Union. The historic building is now partially used as Posiva's offices, while the rest of the building is open to the public and is used as a local resource. Posiva has agreed to rent the mansion for 40 years with all of the rental payments made over for the first twenty years.

Posiva also loaned money to the Municipality for the construction of a new retirement home for elderly people that was formerly housed in the mansion. The Municipality will repay the loan to Posiva using the rental income from the mansion. In addition, a TVO loan investment will cover a local ice hockey stadium project.

TVO and Posiva also arranged funding for a Business Development Fund in Eurajoki during the period 1999-2004. The candidate SNF municipalities were asked to propose societal research subjects for the national nuclear waste research programme in the late 1990s. Five NGOs (three of them local) were funded by the Ministry of Trade and Industry for information activities in relation to SNF management.

E2.4 Korea - LILW [80]

Korea began the process of constructing a LILW disposal facility in 2007. The first phase of the facility was completed in early 2014 and began operation in summer 2015. The site selection process was based on communities volunteering to host the facility with a financial assistance scheme underpinned by national law. The current host community for the LILW facility is Gyeongju and almost £100 million of special supporting funds were made available before the operation of the disposal facility, and will be controlled by the local Government. Additional community benefit funds will be determined by the amount of waste brought to the facility. The special supporting funds will be made available before the operation of the disposal facility, and will be provided to/controlled by the local Government. The rate at which money is placed into the support fund falls under the general supervision of the Supporting Committee for the Local County, which is chaired by the Prime Minister. The local Government must account for its use of the support fund to the committee. The support fund is to be used for:

- local development
- tourism promotion
- expansion of cultural facilities
- projects to enhance income, stable livelihoods, environment and welfare
- other projects prescribed by Presidential decree for local development and improvement in local living standards

As long as the money is spent on public projects the national Government will approve the expenditure. A portion of the disposal fees (as decided by Presidential decree) will be used by the local Government and facility operators to:

- subsidise electricity, public communication, education or for environmental or safety management
- support farming, fishery and tourism
- other projects as required for the development of the local county

E2.5 Social and environmental programmes

London 2012 Olympics Park [87]

The 2012 Olympic Park is located in East London, an area noted for urban decline and high unemployment. From an early stage of London's 2012 Olympic and Paralympic bid it was envisioned to locate the Olympic Park in East London so that the development of the park and associated infrastructure would act as a catalyst for urban regeneration within the five host boroughs. The London Development Agency (LDA) and partners were given responsibility to manage the development of the Olympic Park so to improve East London's economic vitality and social cohesion through a number of initiatives:

- Local Employment Development and Training Framework - The integration of local people into the Olympic Park construction phase was largely facilitated by the creation of LDA's Local Employment and Training Framework.
- City Strategy Pathfinder - This programme provided construction training and employment support programmes.
- New campuses at the University of East London - Birkbeck and Loughborough University College will further develop East London's education opportunities and encourage greater economic development into the area.
- High Performance Sporting and Community Facilities - To ensure a continued socio-economics benefits legacy for East London post the 2012 Olympics, the London Legacy Development Corporation will transform the Olympic Park into an accessible multi-purpose community, leisure and cultural spaces for the East London population while still providing world class sporting facilities for the world's best athletes. These high performance sporting and community facilities include the Aquatics Centre, VeloPark, Eton Manor (tennis and hockey centres and 5-a-side football pitches), Stadium and Copper Box (multi-use sports venue). By 2016, it is hoped these combined facilities will draw over 3 million visitors per year to the Park [88].

Vancouver Olympics [89]

The Vancouver Community Benefits Agreement emerged in conjunction with the City's bid for the 2010 Olympic and Paralympic Winter games and focused, initially, on Downtown Eastside, the old commercial centre of the city. The Downtown Eastside is an area with a rich architectural and community history that for several decades has been characterized by high rates of poverty, lack of adequate housing and abandonment by businesses. Social problems include transience and homelessness, unemployment (22%), high levels of dependence on social assistance, crime, prostitution, HIV infection, drug addiction and dealing.

To date, the Agreement has achieved some success (City of Vancouver, 2007). Nearly 70 development projects - including affordable housing, mixed use complexes, service facilities and others - have been built or are currently in construction as a result of the agreement. The historic Woodward Building is under re-development for housing, educational and commercial uses. The project includes 200 social housing units and 536 private housing units, which sold in a single day on the market. Affordable housing will also be developed in

Southeast False Creek from the 200-250 housing units to be used as the Athletes' Village as at least one-third of these will be designated for low-income households.

A program targeting those with 'multiple barriers to employment' has provided 200 people with one-to-one assistance with housing, childcare and counselling. Through this and other programs some 400 people have found work. The Four Pillars program to address drug-related issues has set up telephone referral services for adults and youth, a Supervised Injection Site which includes detox and referral services, and a webpage with information for service providers and the public. There are four new health clinics in the area. Deaths associated with drug or alcohol abuse, HIV/AIDS and suicides have declined since 2000 and there is less visible drug use and dealing on the street. Other measures to reduce crime and increase safety include: undercover operations targeting pawnshops, convenience stores, SRO hotels and pubs; self-defence training for street-based sex workers; and urban design improvements.

US -Long Island Green Homes Programme [90]

In the US Town of Babylon, New York, the Long Island Green Homes (LIGH) Programme was implemented to retrofit exiting homes for higher energy efficiency. The project was designed in Long Island's most economically distressed community to develop jobs with career pathways. Following a multi-stakeholder input process, a ‘high road agreement’, (an alternate type of community development agreement) was established. This consisted of a stakeholder engagement process to identify strategies for advancing certain goals (also known as High Road Standards), a mechanism for implementing the agreement, and a process for evaluating progress towards goals. This Agreement was overseen by local Government.

The Agreement included funding a resource centre in the neighbourhood that offered pre-apprenticeship training, soft skills development, and wraparound services for neighbourhood residents interested in exploring careers in the green economy. These opportunities were paired with survival employment within the maintenance and operations division of the Town of Babylon.

Long Island Green Homes also worked to connect the resource centre to jobs resulting from its program in order to create a career pipeline. LIGH partnered with LiUNA (Laborers' International Union of North America) to include signatory contractors in home performance work. LiUNA, in turn, worked with the Wyandanch Resource Center and the Long Island Progressive Coalition (LIPC), a community-based organization, to recruit residents from disadvantaged communities for apprenticeships and job placement with their home performance contractors. Each partner played a critical role in creating a strong career pipeline for community members. The Wyandanch Resource Center prepared and supported workers with the greatest barriers to employment to achieve the stability needed to keep their jobs. LiUNA continued the training of these and other local workers in order to place skilled workers with contractors. They also supported small and emerging contractors to increase their capacity to perform the quality work required in the home performance field. In addition to recruiting workers for LiUNA, LIPC quickly added a demand generation component to their community outreach work.

As a trusted messenger, LIPC is able to educate homeowners about energy efficiency and the LIGH program. This created a win for everyone involved: more homes participated in the Long Island Green Home program (800 to date), LiUNA's Opti-Home program resulted in stronger contractors with more work and more jobs were provided for Babylon's most vulnerable residents.

E2.6 Other programmes

As described in the property values section, property valuation schemes have been set up in Canada for both the low-level waste clean-up in Port Hope and for the low and ILW repository at Kincardine. If residents believe that they have been unable to rent or sell their property at the market rate they can apply for an independent evaluation to be undertaken. The Property Value Protection plan provides for compensation for actual losses and must be confirmed by a Qualified Assessor. In Kincardine, funding has also been provided for a nuclear centre of excellence, trades and vocational schools, and international tours.

Some additional examples of Community Benefit Agreements for other large U.S. projects include [91]:

- affordable housing stipulations in planned residential developments
- no-interest loans available to non-profits seeking to increase affordable housing in downtown areas
- construction of a new public park
- streetscape improvements to increase the number of trees, public benches, trash cans, and newly paved roads
- job training programs
- funding of public art
- child care centres
- new public schools
- installation of 'Bird-friendly' non-reflective windows
- development of a centralized food market (heavily desired by residents for years)
- development of a neighbourhood parking lot

Appendix F – The Potential Economic Impact on Agriculture

F1 Background

The latest available DEFRA statistics (June 2013) [92] show that agriculture utilises 17.3 million hectares, representing 71% of the total UK land area. Land uses can be broadly categorised as: arable and horticultural crops, uncropped arable land, common rough grazing, temporary and permanent grassland, and land used for outdoor pigs. This area does not include woodland and other non-agricultural land (roadways, buildings, yards, etc).

In 2013 the Total Income from Farming in the UK was £5.6 billion generated from approximately 222,000 commercial agricultural holdings employing a total of 464,000 within the agricultural workforce.

On a very broad brush categorisation the different types of agricultural enterprises can be split on an east-west basis. Farm types on the west are more grazing livestock oriented (Dairy, Beef and Sheep), whilst those in the east are more arable and pig oriented. The arable sector also includes the more intensive horticultural cropping that has an inherently higher value of output per hectare.

From this very simplistic categorisation it can be seen that the potential economic impact on agriculture of a Geological Disposal Facility (GDF) will be different depending on where it is located within the UK and the specific dominant farming type within that area. For example, the impact within a more upland area, where the agriculture is less intensive, would be less than in a highly intensive lowland area that produces a greater proportion of high value and potentially branded agricultural products.

The potential economic impacts of the GDF on Agricultural businesses can be direct and indirect.

F2 Direct Economic Impacts on Agriculture

There will be a direct loss of agricultural land, both on a permanent and a temporary basis. This will have varying impacts on the agricultural businesses affected as there will be:

- loss of land (reduced output)
- subdivision of the holding (severed land, difficult to access)
- smaller unit size (reduced efficiency)

These direct impacts already have a prescribed method for assessing and calculation of physical and financial compensation.

The headlines on impact assessment and compensation are:

1. Replacement – that is, new land to replace that which is to be taken
2. Mitigation – that is, minimise land take, reduce the impact by design, for example, new access routes to severed land; could include reinstatement of temporarily disturbed land to agriculture
3. Accommodation – for example, field drains, fences/hedges on retained land
4. Compensation – in this context, financial settlement of the net impact, including ‘injurious affection’ of the retained land

All of the above direct impacts on farmland and agricultural businesses are relatively easily quantified and the above method of assessing and calculations of compensation are available and tried and tested.

F3 Indirect Economic Impacts on Agriculture

These impacts may be derived from the perceived risk of the GDF on the potential contamination of agricultural land and therefore the agricultural produce from that land. This economic impact will be influenced by a number of factors:

Intensification level of agricultural enterprise/land use

- level of regional branding
- level of traceability of the commodity
- level of local sales/marketing
- level of farm diversification (farm tourism)

To illustrate this, the potential impact on a small horticultural business selling most of its' produce through their own Farm Shop will be much greater than that of an arable farmer selling wheat into a large central grain cooperative, or a hill farmer running an extensive sheep flock.

When considering a GDF within Cumbria much work was carried out on the potential impact on the Cumbrian Brand [93]. As this area is heavily reliant on tourism the 'brand' image is important to its prosperity. If there were to be a drop in tourism spending within the area then there would be multiple knock on effects on agriculture, for example:

- local supply chains - a drop in revenue affects production levels and will reduce the sourcing of local ingredients
- farm diversification – a drop in revenue for on-farm accommodation, visitor attractions and direct retailing of produce from Farm Shops

It is a fundamental principle of marketing that it costs five times more to recruit a customer than to retain an existing one.

F4 Literature/Research Review

Consideration of the distinct impacts on agriculture and farming businesses from a GDF are not well documented and in most cases these have not been specifically researched as a discrete output. Therefore the literature and research review that has been carried out has drawn upon and where appropriate highlights the potential impact on agricultural and rural businesses.

The HPC Environmental Appraisal [94] concentrated on socio-economic effects on employment, accommodation, demography, local expenditure, primary care and education. The Appraisal concluded that the facility will only have slight/negligible/neutral impacts, and could even have a positive impact on employment.

Within the Hinckley Point C Economic Strategy [95] there were two main concerns expressed on the potential impacts on agriculture:

1. HPC could adversely affect perceptions of the County's food produce.
2. the local labour market may not be able to meet the needs of the agricultural sector

The study concluded that the perceptions are inherently hard to measure and comparisons were made with the tourism survey that suggested the effects are unlikely to be strong.

The impact on the labour market was also difficult to predict. The Appraisal concluded that the proportion of local residents that will work on the HPC is relatively low and will not have wider labour market impacts. However, there will be the potential to make recruitment of seasonal and/or migrant workers difficult. The normal effect of this will be to raise the wages that employers have to pay to fill vacancies. Whilst this is a positive impact for the workers, it will have an adverse impact on the agricultural businesses. However, given the relative size of the agricultural sector compared to HPC and its demand on local labour, the overall scale of any such impact will be small.

A Swiss Energy Study [96] carried out to assess the economic impact of a deep geological repository on the various regions of Switzerland does go some way to putting a monetary value on the economic impact. The Study Report firstly assessed the proportion of agricultural produce that was regionally branded or direct marketed, and then assumed a 5% negative effect on the value of this agricultural produce. For the south of Jura region, which had the lowest proportion of agriculture and, at the same time also with a small proportion of products whose origin is linked with the region, the calculated decline in value added during the construction and operation activities of the GDF will be 0.1 million Swiss francs (£66k) each year. For the Sudranden region, which has the highest share of viticulture in a key region, the calculated decline in value added in Agriculture was 0.6 million Swiss francs (£396k) each year.

The report also quoted some research work carried out in connection with the Niederamt Nuclear Power Station (Switzerland). A group of farmers were surveyed and 67% indicated that the power station had no effects on their sales of agricultural produce, and only two out of 55 stated any negative effects as a result of 'fear' from their customers.

Cumbria Research

The Cumbria research [97] concludes that the most relevant data comes from surveys of residents that report on public perceptions of local economic impacts; most of this research is not from the UK.

In Finland, Kojo, Kari and Litmanen (2010) [98] conducted a piece of research on the socio economic impact of a GDF development. It was based on a survey of 3,000 residents with 1,200 from Eurajoki where the GDF is based and includes 300 replies from residents of Rauma, which is a UNESCO site. With regard to employment a positive effect is estimated by 63%, while 11% estimated a negative effect. In economic development 61% envisaged a positive impact and 10% a negative impact. Services (40% +ve / 11% -ve) and transportation (41% +ve / 15% -ve) were also estimated fairly widely to benefit from the construction of the facility.

The impact on the wider economy was perceived less positively. According to the survey data, the final disposal facility was widely considered to have a negative impact on rural non-farm livelihoods (fishing, hunting, forest product gathering), the state of the natural environment near the facility and the image of the area (to outsiders). A negative effect was estimated by 52% and a positive effect by 12% in the case of the rural non-farm livelihoods. In the case of the state of the natural environment near the facility, 54% anticipated a negative effect and 15% a positive effect. Negative consequences for the image of the area were anticipated by 52% but the positive consequences by 15%. For some respondents, the disposal facility is also perceived to have a negative effect on recreational opportunities (39% -ve / 16% +ve) and on agriculture and forestry (36% -ve / 15% +ve).

In the case of Sweden in April 2008 [99] an independent poll in both communities involved in the site selection of a GDF showed that 83% of Oskarshamn residents and 77% of those in Osthammar supported having the future repository in their own locality. Six neighbouring localities were also surveyed in 2008 and, while the majority of residents were in favour of the final repository in the neighbouring municipalities, support diminished as distance from on-going nuclear power operations increased.

The Cumbrian economic baseline studies [100] investigated the ways in which the publicity surrounding the GDF might impact upon the choices made by businesses, potential visitors to Cumbria and those who consume products that are branded as Lake District or Cumbrian. This concluded that three parallel impacts were possible:

1. Publicity surrounding the GDF has a negative impact on business confidence and their perceptions of growth prospects resulting in cautious investment plans and lack of inducement to start new enterprises.
2. Publicity surrounding the GDF has a negative impact on the perceptions of potential visitors resulting in fewer visitors and lower visitor spend leading to reduced business activity in tourist-dependent activities.
3. Publicity surrounding the GDF has a negative impact on perceptions of potential consumers of Lake District and Cumbrian branded products which reduces sales and leads to reduced business activity in brand-sensitive sectors.

Further brand research work carried out by Ipsos MORI into the Cumbria brand [101] and its importance and resilience revealed that:

- **Proximity**, rather than **provenance**, is often a more important factor for the general public
- For over half of those questioned in the survey (56%), provenance is **not important**

This research indicates that the proximity to a GDF has a greater influence on the public's perception of the "brand" rather than the absolute provenance of a product.

Further work was carried out on 'brand stretch' which investigates the resilience of the brand to negative perceptions up to the 'snap' point, after which the brand revenue sharply dips.

The study showed that (Brand Stretch):

- the Cumbrian/Lake District brand has a great deal of 'stretch' – there is such positivity towards the area that it is able to withstand even severe reputational damage to its brand
- when prompted, participants with such issues as floodings, shootings, and foot and mouth, none were felt to have the severity or longevity to have an effect on the brand
- few issues were felt to be severe enough to actually affect the purchase of produce, either in the short or long term
- However, when pushed hard, participants are able to locate a 'snapping point' around severe radiation exposure; and it starts to 'fray' when contemplating the storage of nuclear waste
- it was difficult for participants to project how this might affect their purchasing decisions – whether on an individual basis or across different products
- the 'snap' was associated with a sudden unforeseen disaster/event, rather than activities that were planned and under control; as such the brand can accommodate activities which may appear detrimental to its inherent brand qualities without suffering any long term damage

Following a 'snap' the Lake District brand would continue and the perception is that demand to visit the area and buy products (food, drink, tourism) would bounce back. However:

- The companies, organisations and consumer brands that service these markets may not survive the consequences of the snap event; the expectation is that others would emerge and replace them

- Whereas associations with Cumbria and the Lake District may impact upon consumer brands in the short term, the area itself appears resilient enough to overcome almost anything.

For the focus group participants, the key anxiety was whether or not the food chain could become contaminated.

The Final Report of the MRWS [102] states that in their opinion:

> *"We have received a good deal of information on generic impacts, both positive and negative, of developing a GDF. Our overall opinion is that, at this stage, we're fairly confident that an acceptable process can be put in place during the next stage of the MRWS process to assess and mitigate negative impacts, and maximise positive impacts. We acknowledge, however that a huge amount of work regarding identifying and quantifying impacts will be required in future possible stages.*
>
> *Additionally, our opinion is that, although they are hard to quantify, we acknowledge there are potential risks to some parts of the economy in the county if the process moves forward, in particular visitor, land-based, and food and drink sectors. We advise that a coordinated strategy and action plan is prepared to support those aspects of Cumbria's visitor and land-based economic activity."*

In notes from a virtual visit to a WIPP in New Mexico [103] carried out by the MRWS Partnership it was surprising that Janet Greenwald (Citizens Against Radioactive Dumping) provided an alternative viewpoint from the WIPP representatives. Her opposition to the plant was mainly on technical grounds. She didn't deny that the social and economic impacts of the facility were predominantly positive.

A Canadian study [104] in Ontario looked at public attitude and tourism research into the effects of a nuclear waste site proposal and found that none of the options would have significant adverse effects on resident, business or farm operator feelings of personal security, community satisfaction or commitment to farming. In addition, residents did not anticipate any changes in their daily behaviour as a result of a long-term waste facility being built in their community. Tourism research found that none of the options would be expected to have any measurable effect on tourist activities or visits. Sixty of the respondents were farmers, and four (7%) of them believed the nuclear waste facility would have a negative effect on their commitment to farming. 67 of the 351 respondents in the neighbouring municipalities identified themselves as farmers. Over 85% of these farm respondents indicated that a long-term management facility would not have an effect on their commitment to farming. Only four respondents (5%) indicated that there may be an effect on their commitment to farming, the majority believing the effect could be positive.

Early work by the International Atomic Energy Agency [105] concluded that repository development may temporarily or permanently remove land from agricultural use. This impact will vary depending on the size of the repository and can potentially affect local agricultural business, decreasing crop revenues and numbers of farm workers employed. The concern regarding the radioactive waste in the repository could affect local image, in turn potentially affecting the sale of certain agricultural products. This may be offset by visitors interested in viewing repository operations, as has been experienced in some Member States.

A broad range of socio-economic and environmental impacts may occur during the repository life cycle. Potential factors that have been identified include those relating to the natural environment, social conditions, economic conditions, built environment and land use. Most impacts are likely to occur at the local level and, to a lesser degree, at the regional level.

Impact management measures can be applied in different ways to eliminate or reduce actual and potential adverse impacts during the repository life cycle. Measures may also be employed to enhance beneficial impacts of repository development and operation.

Public involvement in impact assessment and impact management planning is an important Member State consideration. Such involvement and input, through appropriate mechanisms such as local committees, is particularly important in the project development and operational phases of the repository.

A study carried out in Cumbria [106] into the public perceptions of the potential siting of the GDF within the region concluded:

> *"From a 'place' perspective, the specific location of the site will be a key determining factor as to how people perceive the facility. For example, views on it will clearly differ if it is located in coastal areas, where nuclear related industries are broadly accepted and embraced, as opposed to inland, where they could be seen as a threat to tourism, farming and related industries.*
>
> *There is no consensus of opinion across the three main groups (visitors, residents, businesses) consulted in this research – perceptions are very much based on the individual. The vast majority of research has been delivered prior to the events in Japan – with the very small volume of stakeholder engagement since highlighting how sensitive and vocal opinions in this subject area can be.*
>
> *Clearly partnership working is going to be critical to the further development of proposals in relation to a GDF in West Cumbria, to ensure that the views of residents, visitors and businesses are accommodated. As well as building consensus, this will help to ensure that the benefits of a facility, if ultimately located in West Cumbria, are retained in the area, and that negative impacts are minimised."*

F5 Conclusions

The following conclusions were drawn:

- the direct physical impact of the construction of the GDF and ancillary developments on agricultural land is relatively easily assessed and there already exists a robust method of impact assessment and compensation calculation
- the GDF could raise the average wage paid in the area and therefore increase cost of labour to agricultural businesses
- competition for seasonal/local workers from the GDF could lead to a potential labour shortage for agriculture and/or increased costs. Due to the relative size of the GDF project compared to the agricultural sector in the region, this effect is predicted to be minimal
- a regional 'Brand' including food products shows great resilience to adverse impacts and the snapping point is only reached if there were to be a nuclear accident.
- the impacts on agriculture decrease the further you get from the facility
- a Swiss study showed that the economic impact on agriculture was between £66,000 and £396,000 per year for a GDF in Switzerland

The general consensus of advice is that when progressing the potential siting of the GDF that:

- there should be an acceptable process put in place to assess and mitigate negative impacts, and maximise positive impacts; it is likely there will be a huge amount of work regarding identifying and quantifying these impacts
- public involvement in the impact assessment and impact management planning is important; such involvement and input, through appropriate mechanisms such as local committees, is particularly important in the project development and operational phases
- a coordinated strategy and action plan is required to support visitor and land-based economic activity
- impact management and mitigation measures can be applied in different ways to eliminate or reduce actual and potential adverse impacts during the GDF life cycle
- measures may also be employed to enhance beneficial impacts of GDF development and operation

Appendix G – Additional Figures

This appendix contains a series of additional figures illustrating the following items of information:

- Figure G1: UK unemployment
- Figure G2: Property values and sale prices
- Figure G3: Tourism visitor expenditure
- Figure G4: UK projected population density, 2021
- Figure G5: Household deprivation, 2021

The themes covered by the figures are addressed elsewhere in this report.

Figure G1 UK unemployment

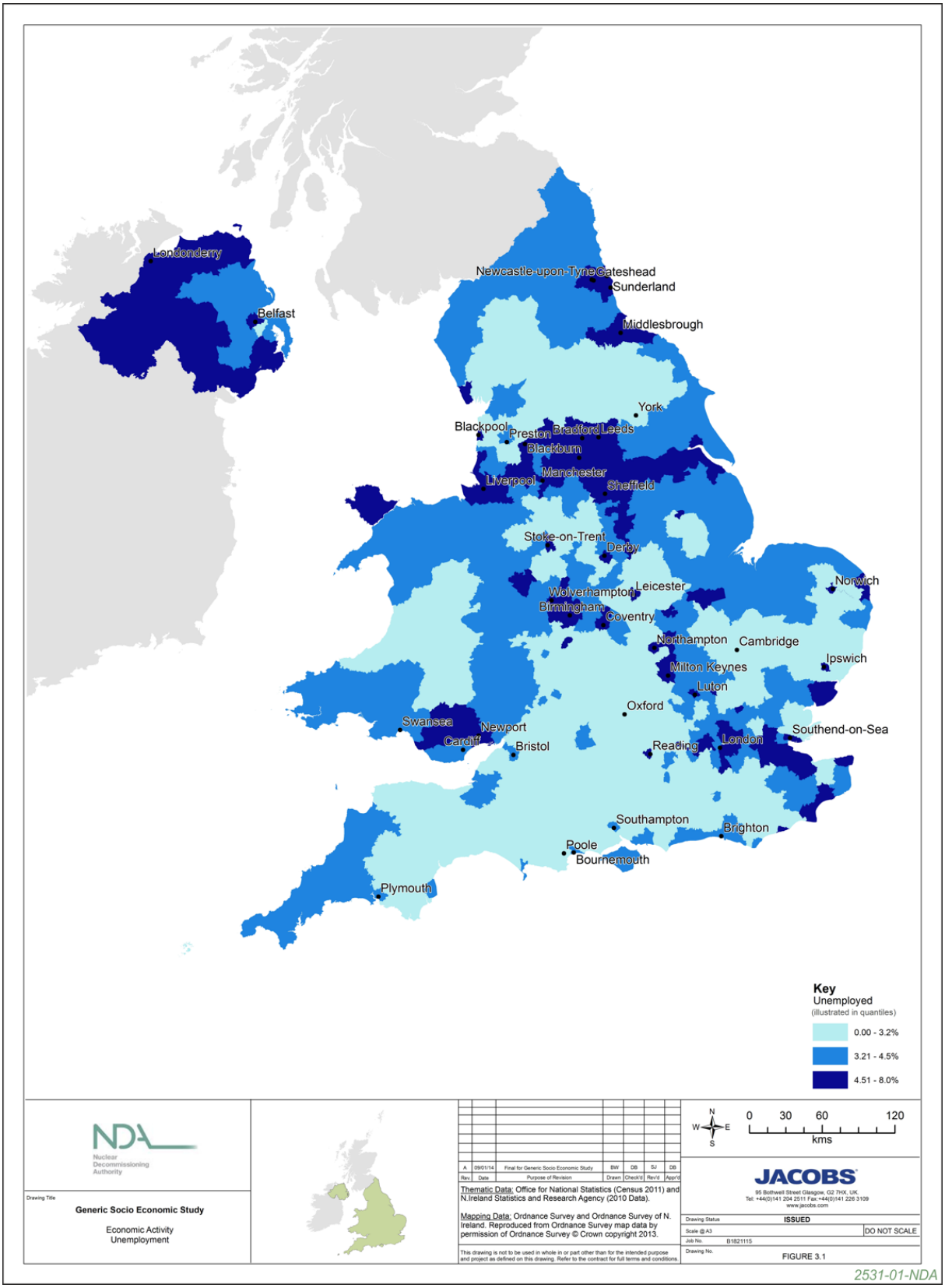


Figure G2 Property values and sale prices

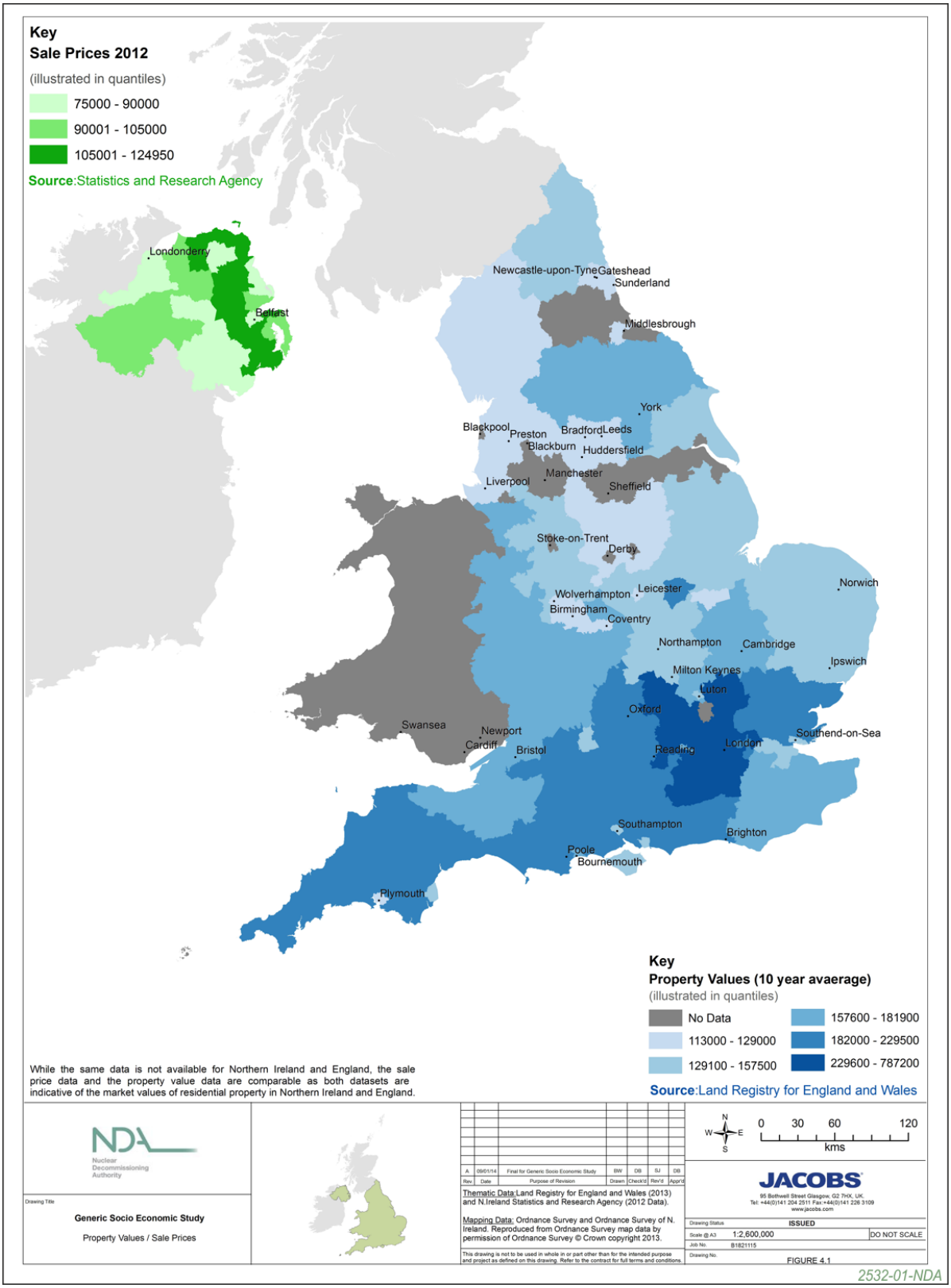


Figure G3 Tourism and visitor expenditure

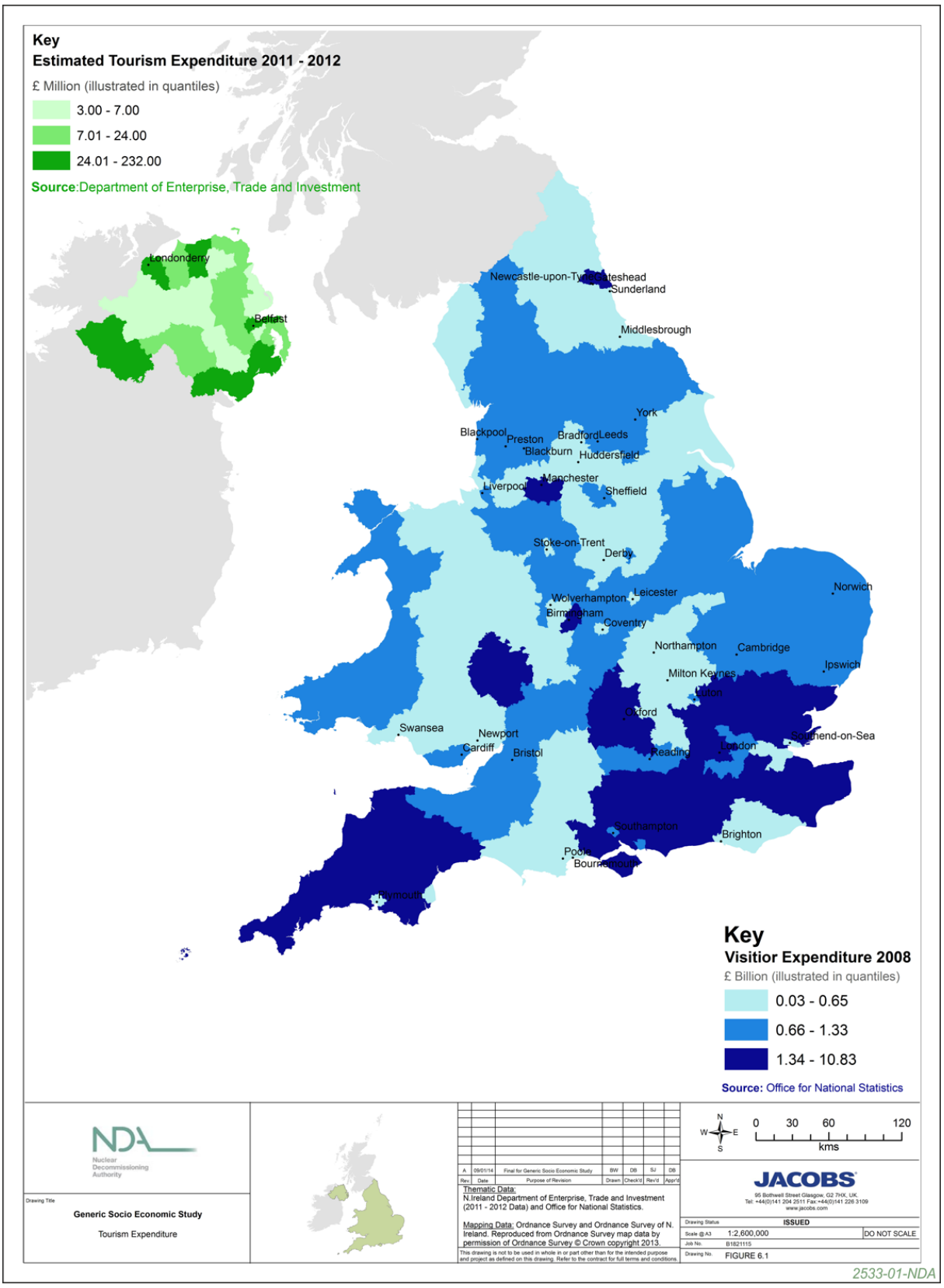


Figure G4 UK projected population density, 2021

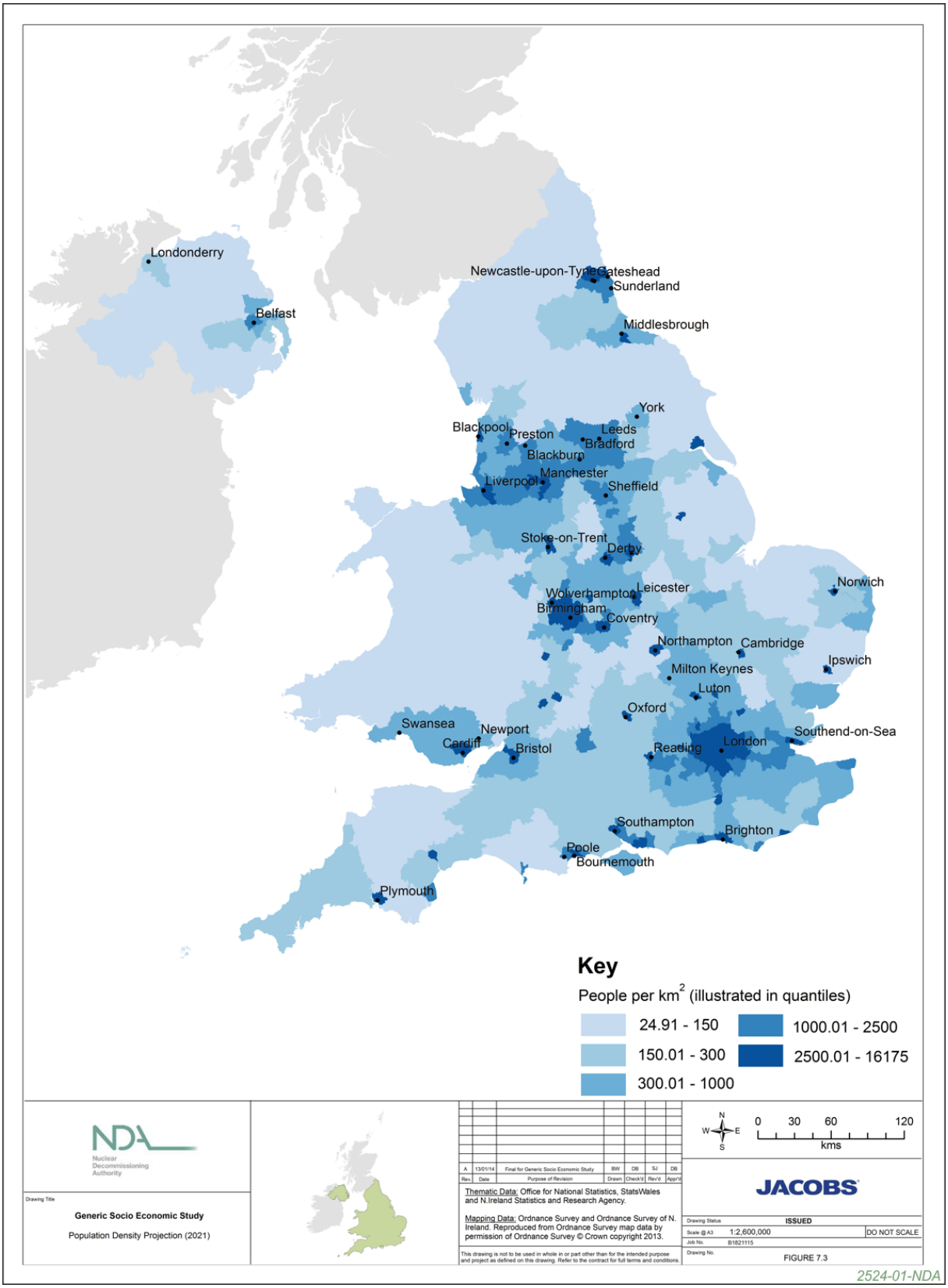
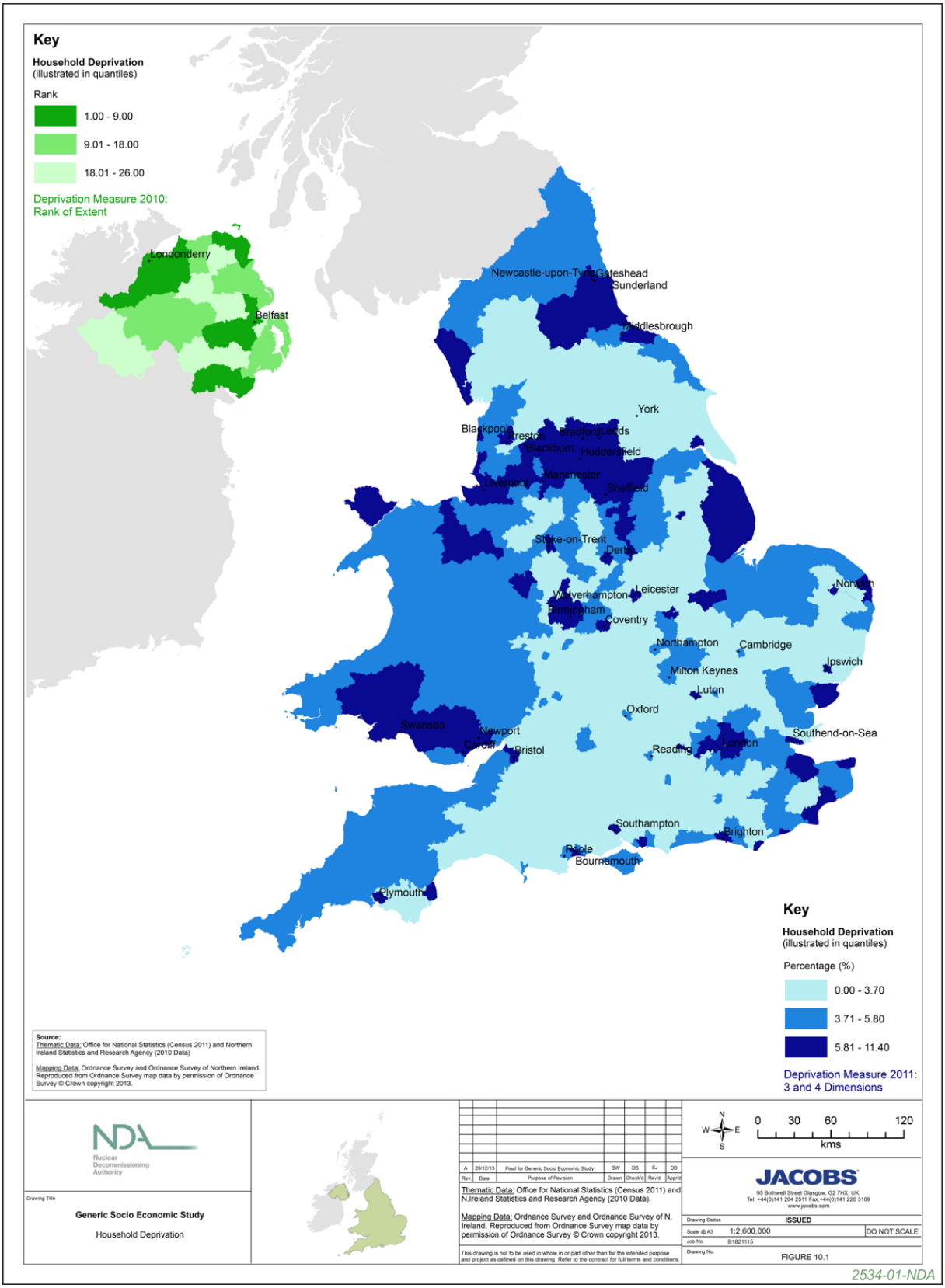


Figure G5 Household deprivation



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