

Geological Disposal

Generic Health Impact 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 generic geological host 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

The policy of the UK Government and the devolved administrations of Wales and Northern Ireland for the long-term management of higher activity radioactive 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 the geological disposal facility (GDF) is likely to take several decades and, once the 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 could be located, the UK Government and devolved administrations of Wales and Northern Ireland favour a consent-based approach, working with communities that are willing to participate in the siting process. The site selection process has yet to be undertaken, so this report is generic, considering 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 assessment considers in generic terms the effects that development of the GDF may have on the health and well-being of the community hosting it. 'Generic' in this context reflects the fact that the assessment is not location-specific. It updates a 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: 'Implementing Geological Disposal – A Framework for the long-term management of higher activity radioactive waste'

The objectives of the assessment are to:

- support the generic design process for the GDF by feeding in potential mitigation measures¹, where appropriate
- support the early stages of the siting process for the GDF
- inform potential host communities of potential effects on health and well-being
- support engagement with stakeholders

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

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

- closure

It is noted that following the initial construction phase, ongoing construction and operation will run in parallel and, as such, the assessments for these phases are considered together, where relevant.

In this generic assessment it has not been possible to determine in detail the likely extent and nature of effects on health and well-being as they will be dependent on the location of the GDF, the characteristics of the host community, and detailed design and mitigation proposals. However, a range of potential health 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 assessment work will be carried out, at a community-specific level, during the siting process.

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

Overall, the assessment concludes that with careful implementation and the adoption of appropriate mitigation and enhancement measures, the GDF should result in a net positive effect on mental and physical health and well-being at both local community and national levels. Key findings from the generic Health Impact Assessment are set out below.

Recreation, amenity and physical activity

Regular physical activity can have many beneficial effects on physical and mental health. Development of the GDF could affect levels of physical activity in a number of ways.

Effects on recreation, amenity and levels of physical activity are anticipated to be negligible during the siting process. From the construction phase onwards, there is greater potential for health effects, as construction activities, changes in local transport infrastructure and alterations to the local environment all have the potential to influence levels of physical activity.

Construction activities will generate increased traffic on the local transport network. Such effects may reduce the attractiveness of walking and cycling, general amenity, and recreational activities, which could lead to reduced levels of physical activity. Conversely, physical activity levels could increase if new recreational facilities, infrastructure for walking or cycling or amenity features are created through mitigation or community investment proposals, or if new transport infrastructure improves the existing walking and cycling environment, or provides access to any new or existing recreational facilities.

A number of potential enhancement and mitigation measures are possible which could help to encourage increased levels of physical activity. These may include the provision, development and/or enhancement of recreational and amenity facilities tailored to local requirements. For example, access for the local community could be provided to any near-site leisure, sports and recreation facilities which may be developed for use by GDF workers. Potential health benefits associated with increased recreation, amenity and physical activity will be explored with local communities and stakeholders during the site selection process.

Transport and health

The construction and operation of the GDF will generate additional transport movements. These will involve, for example, the movement of construction workers and operational staff, visitors, construction materials and equipment, rock spoil and radioactive waste packages. Some of these will be local movements (for example, construction workers and operational staff commuting to work), while some will be regional or national (for example, the transport of construction materials or radioactive waste packages to the site).

Additional traffic generation also has the potential to increase noise levels, and to affect visual amenity and air quality. Measures to minimise such effects will be considered, including maximising the use of rail where possible and development of a travel plan to encourage use of active means of travel and alternatives to car use.

Local transport infrastructure will be developed and enhanced to accommodate additional traffic movements. Where practicable, such measures will be integrated with local transport plans and will seek to complement and enhance local community infrastructure, improving accessibility to local services, reducing congestion and improving road safety.

Community and stakeholder engagement will be critical to exploring and maximising the identification, implementation and uptake of such benefits, and might include the following.

- Provision of new transport infrastructure, which may help to reduce or bypass existing problems such as congestion and road dominance and to improve road safety. This could include new roads, public transport facilities, cycle paths, or footpaths.
- Improvements to existing infrastructure, such as roads, footpaths/bridleways, cycle routes/paths and the introduction of traffic management and safety features.

Consequent health benefits could include improved physical, social and mental health associated with greater use of footpath and cycle routes, reduced driver stress on the road network, reduced accident rates and improved access to social support networks.

Access to community services and facilities

Certain services and facilities are directly linked to the health of a community, such as doctors' surgeries, hospitals, other healthcare facilities and the emergency services. Other facilities also play an important role in community and individual health and well-being. Those facilities, such as schools and community centres that support social networks can be particularly important. Having a reliable support network is recognised as an important determinant of health (that is an environmental, social or economic factor with the potential to influence social, physical and mental health and well-being). Studies show that a healthy social network is key to protecting mental health and plays an important role in improving independence and resilience.

It will be important to ensure that services remain accessible, effective and able to cope with any increased demand as a result of development of the GDF. This issue will primarily be addressed through detailed design, assessment, mitigation and monitoring strategies, with any residual effects being addressed through community support initiatives.

The GDF presents an opportunity to achieve health benefits within a host community relating to improvements in the accessibility and availability of services and facilities. These could be achieved through improvements to the local transport network or via direct provision of new facilities and enhancement to existing services and facilities to cater for both the GDF workforce and local community.

The existence of the GDF may also generate socio-economic benefits in a host community, leading to further investment in community services and facilities. The Government has committed to provide additional investment to the community that hosts the GDF.

Community cohesion

'Community cohesion' is a term describing the level of healthy interaction across a community, including trust and common understanding, participation in civil society, sense of security and belonging, respect for the rule of law, and possession of rights and responsibilities. High levels of community cohesion can have many beneficial effects on physical and mental health. These benefits include improvements in happiness, social

health and support networks and reductions in stress levels/anxiety, fear of crime and actual crime.

As with any major infrastructure project, there is the potential for community contention and concern. There will be aspects that may be seen favourably by some parts of the community and unfavourably by others. As an example, socio-economic opportunities (employment, income, improved amenities and facilities) are typically welcomed by young socio-economically active individuals, but less so by individuals that are retired who may place a greater value on tranquillity and maintaining the status quo. It is this dichotomy that can cause social rifts. In this context it is also worth noting the potential for demographic change associated with the construction and operation of the GDF.

An appreciation of the varying priorities, perceptions and needs of a community, but also within a community, is critical to minimising potential impacts on community cohesion and informing design, mitigation and support initiatives to maximise the uptake of benefits. Transparent, meaningful engagement is the principal mechanism for doing this.

Effective collaboration between the developer, Government, host community and other relevant stakeholders has the potential to support and promote community cohesion during development of the GDF, particularly during the siting process. A comprehensive programme of community engagement will allow local people to interact, share views and influence how their community will develop over time in partnership with the GDF programme. The additional community investment proposed by Government could further help to develop a sense of empowerment within a host community, creating another incentive for particular local groups and the community as a whole to articulate and promote their needs and aspirations.

Radiological safety

Ionising radiation² is naturally present in the environment. Most of this natural radiation comes from radon gas, a product of the radioactive decay of uranium in the earth. Other sources of natural radiation include cosmic rays from space and the presence of naturally occurring radioactive isotopes in food and water. The amount of natural radiation a person is exposed to varies widely around the world. In the UK the annual average is around 2.2mSv³ but the range across counties is between 1.5mSv and 7mSv. These levels of natural radiation are very unlikely to cause health problems.

Before the GDF can be constructed and waste emplacement operations can commence, regulatory approvals are needed from the Office for Nuclear Regulation (ONR) and the Environment Agency (EA). To obtain regulatory approval RWM has to demonstrate, amongst other things, that the radiological risk to individual members of the public and the population as a whole will be as low as reasonably practicable – as well as being within statutory dose limits.

The UK Ionising Radiations Regulations set a statutory dose limit for members of the public of 1mSv/y, from all sources, in excess of natural background radiation. Based on guidance from the Health Protection Agency (now Public Health England) RWM has also adopted a source related dose constraint for the operational phase of the GDF of 0.15mSv/y. Measurable physical health effects at such a low additional dose are considered very unlikely.

² Ionising radiation occurs as either waves (such as X-rays and gamma rays) or particles (such as alpha and beta particles). These waves or particles carry enough energy to remove electrons from atoms, causing them to become charged or ionised.

³ The Sievert (Sv) is a derived SI unit for ionising radiation. It provides an index for the risk of harm from radiation exposure.

During the post-closure phase RWM has adopted a risk guidance level of 10^{-6} per year (this means no greater than a 1 in a million risk of death or serious hereditary defect to any individual per year). At this level mortality risks are considered to be 'broadly acceptable', posing only a very small addition to the day to day risks to which people are exposed.

Even though observable health effects from very low additional radiation doses are very unlikely, there remains the potential for significant health effects related to fear of radiation and increased anxiety levels. This can be mitigated by a pro-active and transparent approach to community engagement on radiological safety issues, to promote understanding of and confidence in the safety of geological disposal.

The GDF is designed to provide a long-term, safe solution to radioactive waste management that does not depend on ongoing human intervention. Its benefits particularly include greatly reducing the burden of responsibility from future generations to actively manage the waste; removing the safety and security risks inherent in having to maintain and protect surface storage facilities for this material indefinitely; and mitigating risks from societal changes, climate change or malicious attacks, any of which could lead to significant adverse health effects.

Environmental effects and health

There are several ways in which the potential environmental effects of the GDF might affect physical and mental health. For example, changes in noise and vibration levels on the local transport network and at the site itself (particularly during construction activities if these are not managed or mitigated correctly) could affect sleep patterns and stress levels; and changes in air quality (from vehicle and plant exhausts, or from fugitive dust emissions) could affect respiratory health.

There are well established methods for assessing, mitigating and managing such environmental effects. Many will be considered and where possible 'designed out' during the siting process. Bespoke mitigation measures will be developed for any residual adverse effects to ensure they are reduced to an acceptable level. For example, consideration will be given to the sensitive routing of construction traffic, to the provision of noise screening if necessary, and to dust suppression measures during surface construction activities.

Where possible, opportunities to provide environmental improvements through enhancement of existing conditions or creation of new features (for example, habitat creation) will be explored. These are likely to be location-specific and will reflect local impacts and the aspirations and priorities of the local community. Further details are provided in the generic Environmental Assessment report.

Socio-economic effects and health

Employment and income are potentially the most significant determinants of long-term health, influencing a range of factors including the quality of housing, education, diet, lifestyle, coping skills, access to services and social networks.

The significant employment and economic benefits that hosting the GDF will bring are likely to have a beneficial effect on physical health, mental health and well-being in a host community. However, the magnitude and distribution of such effects will, to some extent, be dependent on current employment and income levels, and on the degree to which a host community is able to take advantage of the socio-economic opportunities presented by the GDF. Further details are provided in the generic Socio-economic Assessment report.

As well as considering individual themes, aggregate effects have been considered across all themes in terms of both mental and physical health and well-being.

Mental health and well-being

It is recognised that mental health and well-being within a participating community could be adversely affected during the siting process. The Government and RWM are committed to a transparent and collaborative siting process, and to working closely with potential host communities to understand and address their concerns and aspirations. This will include providing information on the potential effects of geological disposal so that people understand what the GDF might mean for them, and involving local communities in the development of detailed proposals for implementation. Such measures will help to build understanding of and confidence in the project, minimising levels of anxiety and potential adverse effects on mental health.

During the initial stages of construction, there are likely to be similar concerns about potential effects on individuals or communities close to the GDF. A robust engagement strategy, including initiatives to deal with hard to reach groups, will be critical to investigating and addressing such concerns through design, mitigation, and in providing the information local communities require. Such involvement will aid in addressing perceptions of risk iteratively and in maximising opportunities to support the host community, presenting an opportunity for a net benefit to mental health.

During operation, as a facility becomes a more accepted feature of the local area and confidence in its safe operation grows, positive mental health effects are likely to continue. Nationally, there may also be positive mental health effects for some communities around existing radioactive waste stores, as they are progressively emptied to more secure facilities and closed.

Towards the end of the operational phase and during facility closure there is the potential for adverse mental health effects associated with the loss of employment and associated economic benefits. As this phase is known and scheduled, mitigation could be developed to manage potential impacts. It is envisaged that a strategy will be explored with the local community closer to the time, taking into account local circumstances at that time.

Physical health and well-being

The net effect on people's health as a result of the range of potential effects identified under the above themes is difficult to assess with any certainty at this generic stage. This is largely because many effects will be location-dependent and because people's interactions with their community and environment are very complex and subject to change (including habits and behaviours, which can change over time and from generation to generation). The overall health effect of the GDF on communities and for different groups of people will also be influenced by the continued adoption of good practice during future, community-specific and location-specific assessment work. Related mitigation and enhancement measures will be agreed through the ongoing engagement and involvement of local communities and other stakeholders in the project. The implementation of appropriate monitoring and management measures will confirm the findings of assessment work and the effectiveness of such measures.

Across the seven themes, a wide range of potential health and well-being outcomes (both adverse and beneficial) has been identified. In terms of potential health hazards, these are well known, understood and can be addressed through planning and mitigation to remove or reduce either the source or the exposure pathway and hence to remove or reduce potential risks.

Potential mitigation and enhancement measures have been identified to minimise adverse effects, and actions have been recommended once a site has been identified to address risk (both perceived and actual) and to maximise the uptake of potential health benefits.

At a local level, there is the potential to realise health benefits due to factors such as improved infrastructure, services and facilities and employment opportunities. However,

effects on health issues vary by theme and actual effects will depend on the location chosen for the GDF.

At a national level, the overall health effects of developing the GDF are likely to be positive, when compared to existing arrangements for surface storage of radioactive waste. As set out above, geological disposal has been selected as a long-term, safe solution to radioactive waste management that removes the safety and security risks inherent in having to maintain and protect surface storage facilities indefinitely. The GDF will mitigate long-term risks from potential societal change, climate change or malicious attacks, any of which could lead to a failure to manage the waste safely were it not in the GDF.

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1 Introduction

1.1 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 Ireland⁴ 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.

⁴ 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.

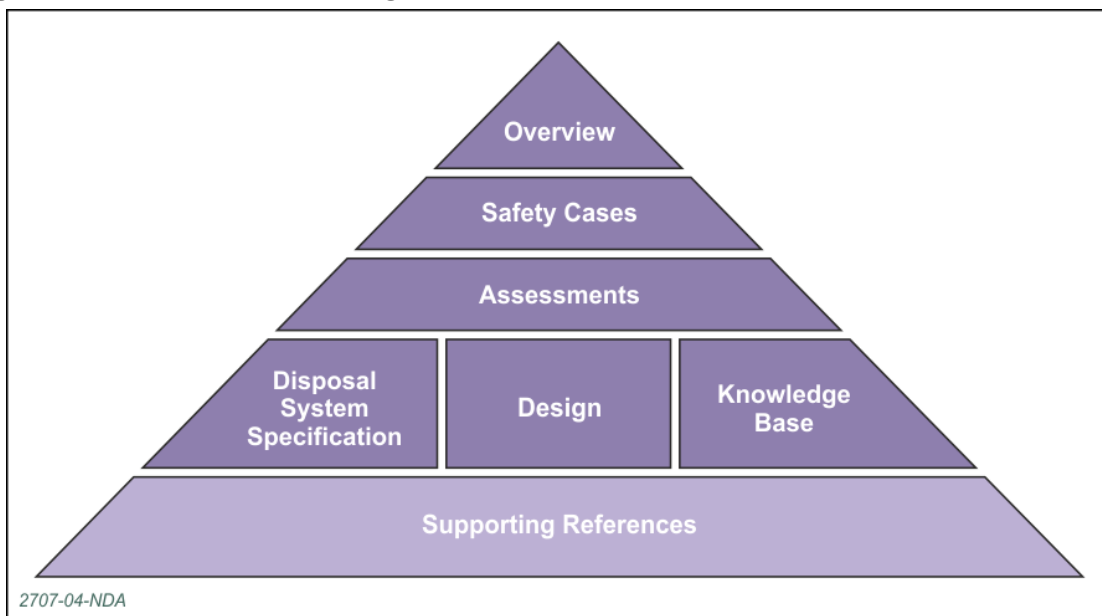
High level information on the inventory for disposal, the illustrative disposal concepts and other aspects of the disposal system is collated in a technical background document (the Technical Background) [3] that supports this generic Disposal System Safety Case.

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 Health Impact Assessment

This report is the generic Health Impact Assessment (HIA).

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

It is new to the generic DSSC, but updates a generic Health Impact Assessment produced in 2014 [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, Government policy as set out in the 2014 White paper and updates in health assessment good practice.

1.3 Objective

The objectives of the assessment are to:

- support the generic design process for the GDF by feeding in potential mitigation measures⁵, where appropriate
- support the early stages of the siting process for the GDF
- inform potential host communities of potential effects on health and well-being
- support engagement with stakeholders

In particular, RWM's generic health impact assessment work aims to:

- identify potential hazards and establish how they are addressed through design to manage and remove potential risks to community health
- qualitatively appraise the potential magnitude, distribution and likelihood of potential health outcomes (both adverse and beneficial) directly attributable to the GDF
- provide recommendations that may be considered during the continuing design process for the GDF

1.4 Scope

1.4.1 Technical scope

Potential health effects have been assessed across the following themes:

- recreation, amenity and physical activity
- transport and health
- access to services and facilities
- community cohesion
- radiological safety
- environmental effects and health
- socio-economics.

The environmental and socio-economic 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

⁵ 'Mitigation' in this sense is anything which avoids, reduces, remedies or compensates for an adverse effect.

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 GDF at the current generic stage.

1.4.2 Temporal scope

The generic HIA 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 activities associated with closure of the GDF

1.4.3 Geographic scope

The assessment does not focus on any specific area or site and considers the generic 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 reports will include formal Environmental Impact Assessment (EIA) at the appropriate stage.

1.5 Document structure

The remaining sections of this report are structured as follows.

- Section 2: Approach and Methodology – explains the overall approach and methods used to assess the potential health effects of implementing geological disposal
- Section 3: Health Assessment sets out the potential beneficial and adverse health effects that may arise throughout the life cycle of the GDF, under each of the themes identified in the technical scope, at a level suitable for the generic level of assessment
- Section 4: Next Steps
- Appendix A presents more detailed information about the methodology for health assessment

2 Approach and Methodology

2.1 Health impact assessment

2.1.1 Approach

The approach taken to the generic HIA builds upon that of the previous work [4] and is based upon a broad socio-economic model of health, which incorporates both conventional health hazards (for example, accidents, risk and disease) as well as wider health determinants necessary for achieving good health and well-being.

The generic HIA follows and builds upon existing good practice guidance for HIA but also considers examples of nuclear-related HIA best practice and transferable knowledge [8]. A central aspect of the approach has been to draw from and build upon the wider generic assessment information, including the generic Environmental Assessment (EA) report [7] and the generic Socio-economic Assessment (SeA) report [6].

2.1.2 Methodology

Although guidance exists, the methods employed in HIA are often tailored to meet the particular assessment requirements of a project. In this instance, and as discussed below, the generic HIA methodology includes two stages: review and qualitative assessment.

2.1.3 Review

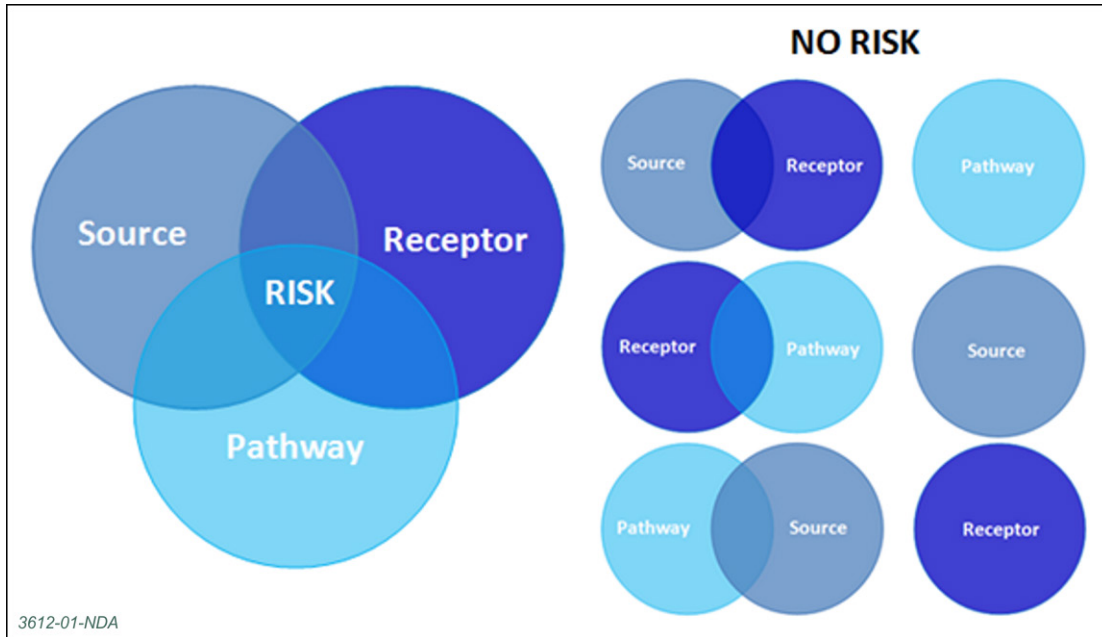
A review of the previous generic HIA, available strategic information and available literature has been performed to outline the core activities and associated health pathways to be investigated in greater detail within the appraisal stage.

A health pathway can be defined as any activity or aspect of a project with the opportunity to influence health, both adversely and beneficially. Identification of potential health pathways helps to define and structure the study, from which it is possible to develop a suitable evidence base and appraise the potential distribution, magnitude and significance of health outcomes directly attributable to the project.

2.1.4 Qualitative assessment

The basis of any health assessment follows the fundamental process of identifying any potential hazard source (that is an activity or substance with the potential for harm) and then exploring credible opportunities for such hazards to come into contact with a receptor (that is a community, individual or sensitive community group) with the potential for disproportionate outcomes.

As shown in Figure 2, a hazard by itself does not constitute a risk, it is only when there is a hazard source (for example, air pollution) and a pathway of exposure that there is any potential for risk to a receptor. Similarly, where there are no receptors (for example, local residents, users of local facilities), a hazard source would not constitute a risk to health.

Figure 2 Assessing risk through the source-pathway-receptor concept

Where a source-pathway-receptor linkage exists, the nature of the specific hazard source and the magnitude and concentration of exposure will define the level of risk.

At this stage, given no project or community specific information is available, only a high-level qualitative assessment based on professional judgement is possible to allow potential hazards and allow any credible pathway of exposure to be addressed and assessed following site selection.

This report builds upon the previous generic HIA and updated baseline information to investigate each phase of the GDF to appraise potential health outcomes.

2.2 Sensitive community groups

Evidence suggests that different communities and sensitive groups have varying susceptibilities to health impacts and benefits as a result of broad social and demographic structure; behaviour and relative economic circumstance, which is related to individual circumstance.

RWM's proposed approach to equality impact assessment [9] notes that under the Equality Act 2010 (applying to England and Wales⁶), public bodies are required to assess the effects of their activities and decisions relative to equalities issues and to be transparent and accountable to communities about the decisions they are making.

On this basis, and in accordance with the Equality Act, the generic HIA considers any potential for disproportionate health impacts between groups exhibiting any of the 'protected characteristics' defined by the Act. These characteristics are age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion and belief, sex and sexual orientation.

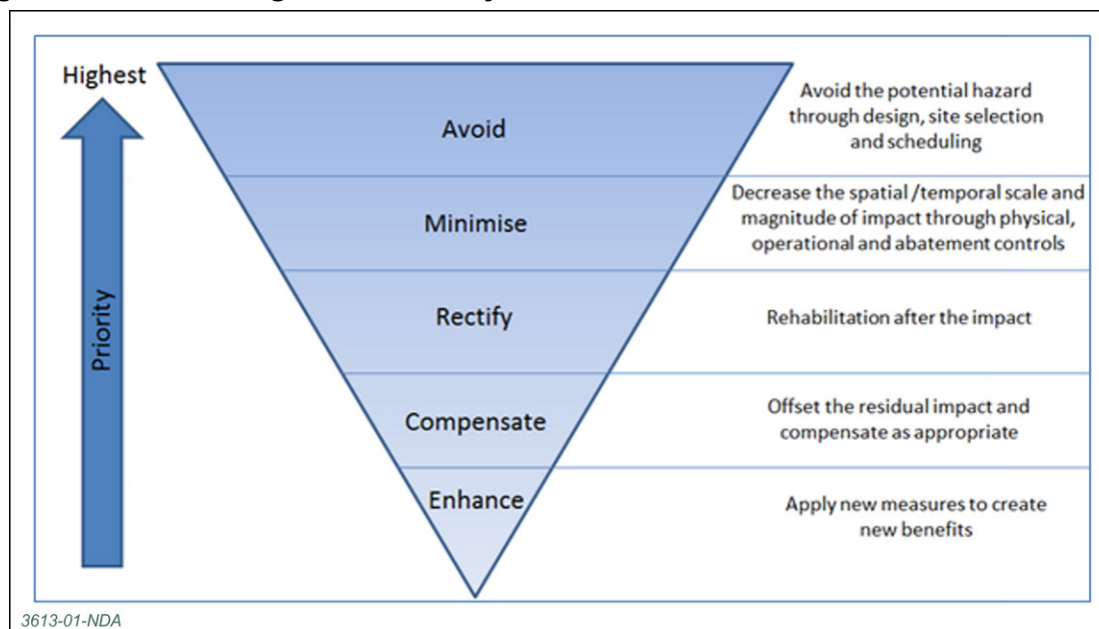
This list of characteristics may be further refined or modified during the siting process, to take into account the individual characteristics of potential host communities, including existing burdens of poor health and relative sensitivity to what is proposed.

⁶ Does not apply in Northern Ireland. However, Northern Ireland has its own range of equalities legislation. For more information, see the Equality Commission for Northern Ireland website: <http://www.equalityni.org/>.

2.2.1 Mitigation

This report sets out potential mitigation measures, at a level suitable for the generic assessment. More detailed mitigation proposals will be developed during future site-specific stages of assessment. Such mitigation will take into account the mitigation hierarchy set out in Figure 3.

Figure 3 The Mitigation Hierarchy



2.3 Uncertainty and limitations

This report considers effects at a generic level; it does not consider the implementation of geological disposal at a particular location and reflects a relatively high degree of uncertainty at this early stage of the development, as described below.

- Some effects will be location-specific, reflecting existing conditions. These may include physical features and conditions, such as the availability and capacity of existing community infrastructure, and the health-related characteristics of the community, including baseline conditions for both physical and mental health.
- Many effects will be dependent on the detailed design of the GDF and its associated infrastructure. The generic HIA is reliant upon illustrative designs for three different rock types. A detailed design is unlikely to be developed until a preferred site has been identified.
- The way that geological disposal is implemented will reflect the concerns, aspirations and priorities of a host community which, at this stage are largely unknown.

To address these uncertainties RWM's generic assessment work has considered a range of plausible implementation scenarios and potential effects. It attempts to identify any particular variables or specific groups that could be particularly sensitive to the effects of the GDF and considers how potential mitigation and enhancement measures might influence the overall outcomes.

Without details about a specific community's location or characteristics, effective forecasting of future health-related issues and conditions is not possible at this stage. Therefore, no such forecasting has been attempted in this assessment; this will be undertaken following site selection.

Consideration has been given to the identification of a generic population based upon national trends. However, it is considered that this would provide limited information at this time, as regional and local variation is significant and could potentially mask pockets of socio-economic deprivation, existing burdens of poor health and relative sensitivity at this stage of assessment. It is therefore recommended that future stages of assessment consider location-specific socioeconomic and health conditions, once the siting process is underway.

A key uncertainty arises from the long-term nature of the project and challenges in forecasting baseline conditions and relative sensitivity to specific activities over periods of more than 100 years. As an example, from a public health perspective, the demography of communities is changing, where life expectancy has and continues to increase. This change will significantly influence baseline health data and disease prevalence rates (for example cancer, cardiovascular and respiratory). Current health sensitivities and priorities may therefore be very different to those of the future, as may the scientific evidence base.

Whilst it is not possible to account for such uncertainties in this generic HIA, it is important to note that such factors, as well as any advancement in the current scientific evidence base, will be captured and driven through national policy during the refinement of environmental standards set to protect the environment and health. On this basis, the key uncertainty associated with the extended temporal nature of the project is (and will remain) addressed throughout the lifetime of the project by the iterative review and amendment of national policy.

2.4 Future development of the HIA

The assessment work for geological disposal is being undertaken at three levels as described below.

- Generic assessments such as this generic HIA – referred to as ‘generic’ as no particular community or site has been identified to host the GDF. These assessments generate indicative information about the potential effects of geological disposal, based on specific assumptions about the design. These assessments help to develop an understanding of the potential risks and opportunities associated with the GDF, to provide better transparency to communities that may wish to participate in the siting process and to inform further design and assessment work.
- Community-specific assessments, to support the siting process for geological disposal.
- Detailed, site-specific assessments (for example, an Environmental Impact Assessment (EIA), integrating Health Impact Assessment) to support detailed design work, decisions about the selection of a preferred site and the statutory land-use planning process.

It is envisaged that RWM’s generic HIA work will be further developed at more detailed levels as the GDF progresses through the siting process.

To facilitate this, this generic HIA sets out actions to be taken forward following site selection. This provides a mechanism for ensuring that potential outcomes, associated mitigation and enhancement measures identified at the generic level are carried forward and can be explored in more detail with stakeholders and communities during appropriate future phases of the project.

3 Health Assessment

3.1 Introduction

The previous generic HIA provided a robust scope of potential health hazards and pathways for the key phases of the life-cycle of the GDF. This assessment builds upon the strengths of the previous assessment, expanding upon the assessment where updated information is available and recommends future actions.

For consistency, this assessment follows the structure of the previous generic HIA and appraises potential health outcomes under the following health theme headings:

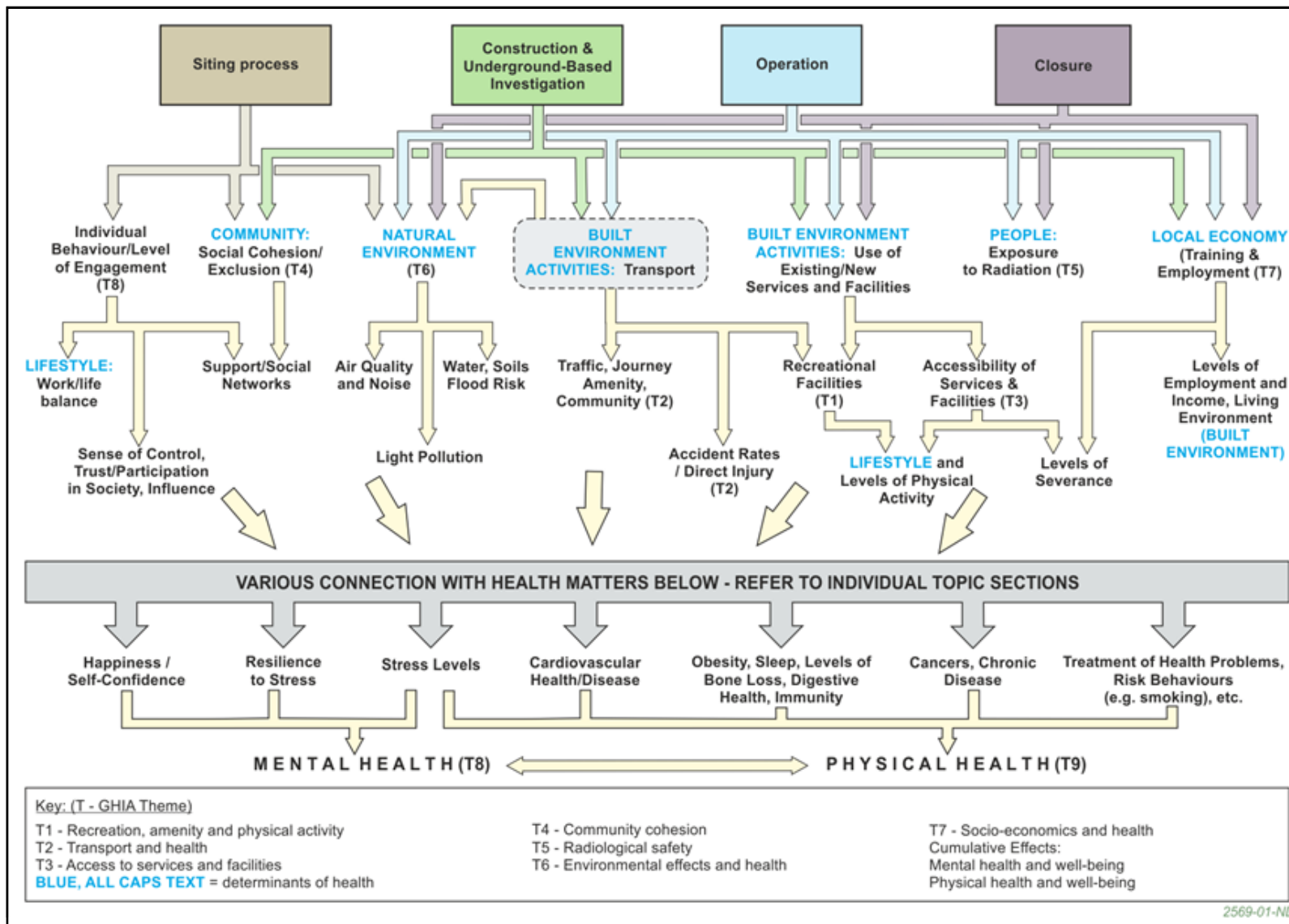
- recreation, amenity and physical activity
- transport and health
- access to services and facilities
- community cohesion
- radiological safety
- environmental effects and health
- socio-economics

In addition, the following are included within this generic HIA.

- Further consideration of the potential impact upon local health care capacity within the 'access to services and facilities' theme, due to demand from GDF personnel.
- A consideration of the issue of perceived risk and the impact that this may have on communities and their health. This is addressed within each health theme, where actions are suggested to explore and address community concerns through meaningful engagement, and the factual investigation and dissemination of robust information.

Figure 4 presents a summary of the potential health pathways and outcomes of the GDF. The following assessment is structured according to the health themes listed above and presented in Figure 4, investigating the potential health outcomes and any actions or further assessment recommended to be implemented following site selection.

Figure 4 Potential influence on health from the GDF [5]



3.2 Recreation, amenity and physical activity

3.2.1 Overview

Recreation, amenity and physical activity play a significant role in maintaining good social, mental and physical health, where sedentary lifestyles can contribute towards health risks, such as increased obesity, Type 2 diabetes, coronary heart disease/stroke and some types of cancer prevalence [10] [11] [12]. In addition, evidence suggests that increased access to social networks, amenities and facilities can improve perceptions of risk and personal safety, further encouraging walking and activity, particularly within vulnerable groups, including older people and the infirm [13].

Considering the increasing age of the population in the UK, there is an increasing need for projects that promote active lifestyles and minimise any adverse impacts on recreation or access to amenities and facilities.

There may be both adverse and beneficial outcomes associated with the development of the GDF in relation to recreation, amenity and physical activity. Potential adverse outcomes may result from construction of the facility, such as the introduction of community barriers (severance) or diverting, reducing or removing access to amenities, facilities and areas of recreation and social interaction.

In contrast, potential opportunities may be associated with opportunities for improvements to and enhancement of infrastructure to facilitate improved access to amenities, physical activity and community cohesion.

The following section investigates and appraises the potential for each phase of the life-cycle of the GDF and provides guidance and recommendations to reduce adverse impacts and maximise opportunities once a location has been identified.

3.2.2 Potential health outcomes (both adverse and beneficial)

As shown in Figure 5, the potential health outcomes directly attributable to the GDF with the potential to influence recreation, amenity and physical activity vary by phase and duration. These are closely linked to environmental and transport effects.

Environmental factors include the following.

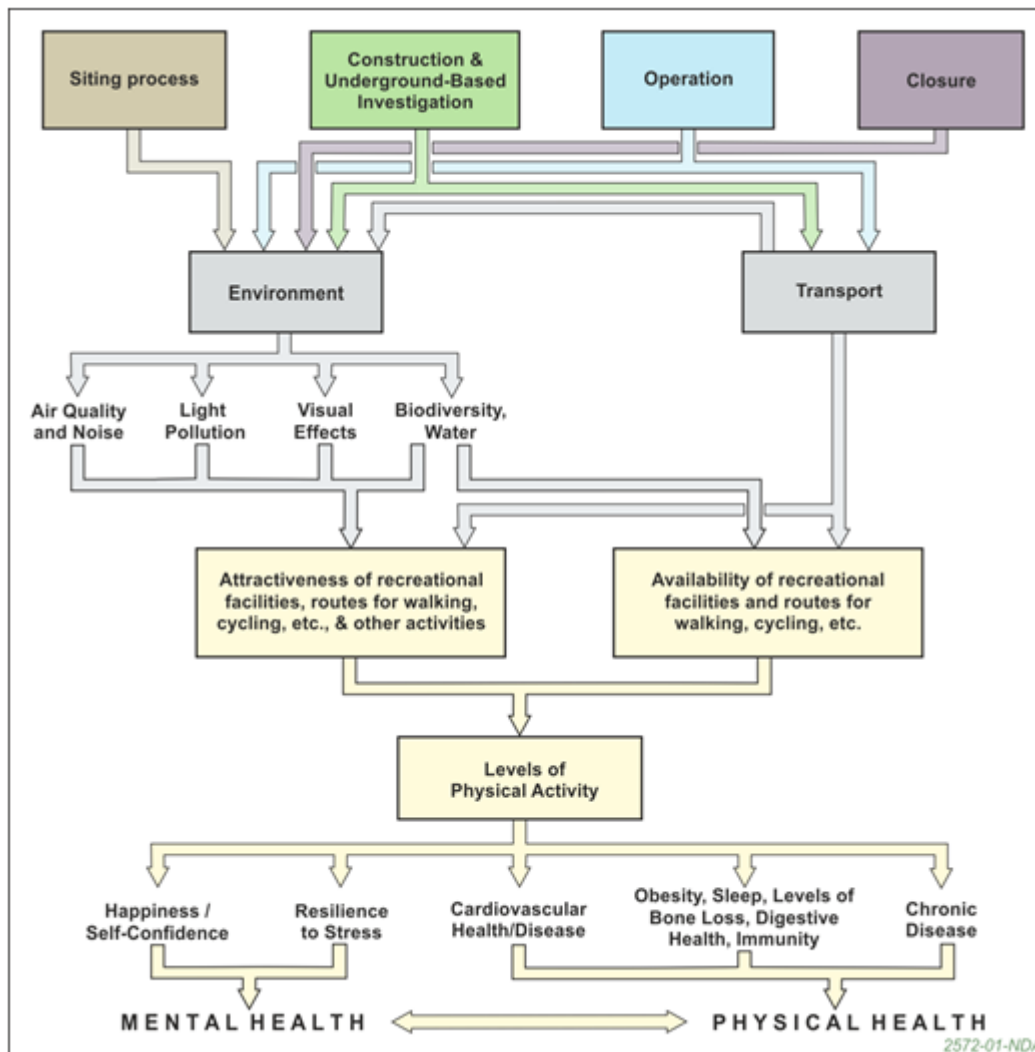
- Any potential disruption to, or removal of, public rights of way or areas of open/recreational space, with the potential to result in community severance and to impinge upon physical activity and access to social networks, amenities and facilities.
- Changes to the local environment (noise, emissions to air, visual impact), influencing perceptions, behaviour and patterns of physical activity and social networks.

Transport factors include the following.

- Changes in the local road network (such as provision of new roads and/or a change in traffic rate and nature on existing roads), with the potential to influence community severance and access to recreation, amenities and facilities.

The ways in which, and the extent to which, recreation and amenity facilities and levels of physical activity will be affected will depend on location-specific issues within individual communities. Therefore, at this generic stage, the generic HIA has focussed on potential effects that might be associated with this theme by phase of the life cycle of the GDF.

Figure 5 Generic HIA considerations for recreation, amenity & physical activity [5]



3.2.3 Sensitive community groups

Groups within a community that may be particularly sensitive to effects on recreation, amenity and physical activity (and consequently on several aspects of their physical, social and mental health) include those with reduced mobility and limited access to private vehicles. These include the elderly, children and economically deprived groups, who may be more heavily dependent upon local recreational facilities, as they are less able to access alternative options. This can be especially significant for communities in rural areas and other areas without access to good public transport services.

Other groups that may experience increased sensitivity to effects on recreation, amenity and physical activity are those groups that may be vulnerable to discrimination or fear of crime. This might include lesbian, gay, bisexual, transgender or minority ethnic groups.

3.2.4 Siting process

The siting process will involve drilling a number of boreholes around potential candidate sites within volunteer communities. Drilling at each borehole site will require the establishment of a secure compound/work site and will generate transport movements. The siting process may last approximately 10 years. However, borehole activities at any

one location are likely to last approximately 6 months (with possible borehole monitoring after this time).

As discussed in the generic EA report, borehole site activities will generate some limited increase in traffic movement, including both heavy goods vehicles and cars. However, the quantity of road traffic likely to be generated is relatively small, such that significant effects on the local community or the environment would be unlikely to arise. Noise, vibration, lighting and dust effects could be mitigated through construction management methods and it is unlikely that significant effects will arise. The GDF will be required to comply with regulatory standards set to protect the environment and health. The potential impact upon public access and areas of open space will be location-specific (depending on the proximity of such areas and the nature of their use).

Because of their temporary nature and the relatively small scale of these activities, such effects are considered unlikely to be significant, but over a limited period they could influence how frequently and effectively people use nearby recreational and amenity facilities and the outdoors more generally for recreation. In terms of mitigation, consideration should be given to locating borehole sites away from recreational facilities and areas used by local residents for physical activity. Any residual effects could be monitored and controlled through the development and implementation of an environmental management plan for the borehole programme.

3.2.5 Initial construction and underground-based investigation

During this phase of development, there will be potential for effects on levels of recreational and physical activity related to transport and environmental effects. These could arise from alterations to the road network and increases in traffic flows, which could influence actual or perceived levels of safety in the vicinity of a site, resulting in potential changes in access to recreational and amenity facilities and levels of physical activity. Other effects such as changes in noise levels, visual amenity and air quality could also influence behaviour and levels of physical activity, as these changes could alter people's enjoyment or use of local recreational and amenity facilities and resources.

Given the duration of the construction phase and the likely extent of the proposed workforce (particularly during the initial construction stage), there is also a potential risk of increased demand on local recreational facilities and amenities from construction staff (and their families and dependants). Opportunities should be explored to address this, taking into account local conditions. These could include provision of new, or improvements to existing, recreational, leisure and sports facilities for workers and the host community.

The initial construction stage will result in the highest levels of traffic generation. Following site selection, a number of mitigation measures will be explored to reduce the potential for adverse transport-related effects, and where possible, to enhance positive effects. These might include measures to reduce the use of cars by construction personnel, together with the use of rail for delivery of bulk materials. In addition, consideration will be given to facilitating improvements to local public transport services or, where appropriate, a staff accommodation strategy.

Such measures would help to reduce the potential for community severance in terms of recreational and amenity features caused by increases in traffic flows or congestion. Where appropriate, opportunities for enhancement should be considered. This might include creation of new transport infrastructure, such as roads, footpaths/bridleways and cycle ways, which could provide or improve access between existing communities and recreational and amenity facilities. Community engagement will be critical to exploring local perceptions, priorities and needs; and then addressing them through design and mitigation measures.

Mitigation measures that could be adopted to help manage and mitigate environmental-related health effects include adopting good practice construction techniques to reduce the adverse effects of construction activities at source. These should include consideration of different construction methods and the timing of works likely to cause nuisance. The installation of bunds to mitigate visual effects and reduce construction noise levels would also provide mitigation at this stage. As set out in the generic EA, opportunities will be explored to provide benefits for wildlife and semi-natural habitats and to enhance habitats around the GDF. This could, in turn, encourage recreational activities such as fishing and bird watching.

As with the borehole programme, residual effects will be monitored and controlled through the development and implementation of an environmental and transport management plan for the construction of the GDF.

3.2.6 Ongoing construction and operation

The operational phase will overlap and run parallel to the ongoing construction phase following waste emplacement. As such, activities with the potential to influence health are likely to be similar to those during construction, although the physical extent of the site (above ground) will not increase during this phase. Although the nature of effects will remain largely unchanged between the construction and operation phases, the extent/scale of any adverse effects is likely to be reduced as surface activities will be less intensive than those required during the initial construction phase; and mitigation and enhancement measures such as landscaping, habitat management and creation will become established. This has the potential to encourage visits to and use of recreational and amenity features in the area, particularly where infrastructure such as footpaths and cycle ways are created or improved as part of project implementation.

3.2.7 Closure

Potential activities during the closure phase that may influence health are anticipated to be similar to those during the initial construction phase. However, the scale of these effects during closure will be greatly reduced. The nature of site restoration following closure will be explored with the local community at the time, but there may be potential for net enhancements to recreation and amenity facilities and levels of physical activity depending on the end use of the site.

3.2.8 Potential health benefits

Potential health benefits associated with increased recreation, amenity and physical activity will be explored with communities and stakeholders following site selection. These may include the provision, development and/or enhancement of recreational and amenity facilities tailored to local requirements. It is important, however, to ensure that any such provision is viable and sustainable for the host community and is tailored to the needs of the particular community.

3.2.9 Future actions

Some or all of the following measures could be adopted to mitigate any adverse effects and to make the most of opportunities for improvement.

- A comprehensive community engagement strategy could be developed, to engage with key health stakeholders, local residents and under-represented groups, to inform planning, further inform the scope and focus of technical assessments and explore local community circumstances, priorities and requirements (including opportunities to improve local recreation, amenity and physical activity).

- EIA and other community/site-specific assessments will be undertaken following site selection to include (amongst other technical assessments) an assessment on health effects, including potential effects on recreational and amenity facilities.
- Potential site-specific effects on community, amenity and recreational facilities and areas of physical activity will be considered within the site selection processes to inform the site-specific design of the GDF to reduce potential effects.
- Following site selection, a community liaison group could be established to facilitate greater input to the design process, but also to feedback information to local communities (key to addressing risk perception).
- A management plan or plans could be provided to manage environmental, transport, social, recreational and public health requirements, aiming to reduce potential impacts on local capacity and availability, and facilitate the integration of construction staff within existing communities.

3.3 Transport and health

3.3.1 Overview

The potential health outcomes associated with transport are complex, spanning environmental, social and economic health factors. Transport benefits individuals through greater access to income, employment, education, social and recreational opportunities important to social, mental and physical health. However, transport represents a significant source of the majority of urban noise and emissions to air and can result in community severance and risk of road traffic accidents and injury.

As transport can be linked to many of the other health themes identified in this generic HIA, it has been necessary to restrict its consideration here to issues directly related to the use of transport infrastructure (for example, public transport, driving, walking, cycling or horse riding). Where appropriate, the effects of transport on other aspects of health are discussed under each of the relevant themes.

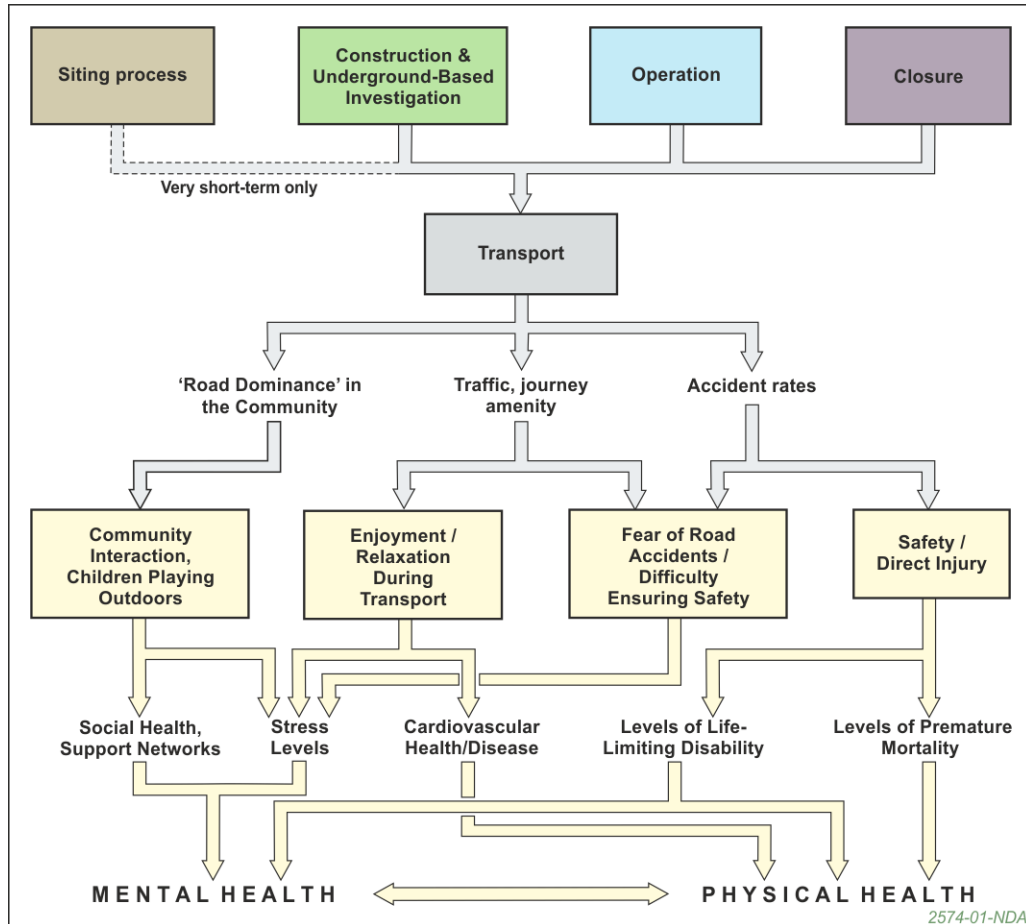
3.3.2 Potential health outcomes

As shown in Figure 6, the activities with the potential to influence health include the following.

- Changes in the nature of the road network, affecting perception and community severance from 'road dominance' (the extent to which a transport network is dominated by vehicle use and the effects this has on community behaviour and interaction)
- Changes in traffic levels and changes in journey time and quality (amenity/stress) on the existing transport network
- Risk of accident and injury from changes in road traffic nature and movements

Potential transport-related health outcomes associated with changes in air quality and noise are addressed under the 'environmental health' theme (Section 3.7).

The ways in which, and extent to which, road dominance, traffic/journey amenity, stress and accident rates will influence health will depend upon location-specific issues within individual communities. Therefore, at this generic stage, the generic HIA has focussed on potential effects that might be associated with this theme by phase of the life cycle of the GDF.

Figure 6 Generic HIA considerations for transport effects [5]

3.3.3 Sensitive community groups

Research indicates that the distribution and severity of transport-related health effects varies within communities. Rural, sparsely populated communities, where facilities and services are further apart and people are more reliant on car or public transport, can be more sensitive to changes on the local transport network.

Those groups with lower incomes may also be more sensitive to change, as their mobility is constrained by the availability of public transport services and the level of provision for pedestrians and cyclists.

Increases in road traffic and congestion can also amplify community severance for certain groups such as the elderly and disabled, who may be more deterred from crossing busy roads and less able to make use of possibly longer alternative routes. Conversely, these vulnerable groups are also likely to be more significantly affected by improvements to the transport network [14].

3.3.4 Siting process

During the siting process there will be a slight increase in traffic on the local road network associated with the movement of staff, construction materials and machinery for the borehole programme.

Such a slight and temporary increase is unlikely to impact materially upon local transport flow, congestion or result in any significant adverse health outcome from journey amenity. Although this is the case, due to a combination of factors, rural roads in particular can be subject to a higher prevalence of road traffic accidents. The risk of accidents can be a

significant concern for local residents that share public roads and highways (be it in a private vehicle, on a horse, bicycle or as a pedestrian).

On this basis, whilst the likelihood of a traffic collision is low during this particular phase, the risk and community perception of risk may still exist. This will need to be explored with local residents and stakeholders and managed through design, mitigation and a suitable management plan.

3.3.5 Initial construction and underground-based investigation

Adverse health effects relating to transport are most likely to occur during this initial construction phase as this is the phase with highest levels of activity and where the greatest change in the local land use will occur. This phase is anticipated to generate the highest levels of traffic movements, including increases in the number of heavy goods vehicles (HGVs) and workers commuting to and from the site. HGV traffic flows will be dependent on the rock type and on the extent to which the rail network can be used. Traffic flows arising from staff and visitor transport are currently anticipated to be higher than flows associated with HGVs, perhaps reaching approximately 600 per day during the initial construction period.

The number of HGVs on the local road network will depend largely on the early availability of the rail link to the site, which could be used to bring in bulky and abnormally large equipment and construction materials. New transport infrastructure may also be required during this phase. Project-specific mitigation measures would be explored and might include improvements to local transport networks and services.

Mitigation and enhancement might also include improvement of existing, or the creation of new, transport infrastructure such as roads, footpaths/bridleways and cycle ways, which may directly provide or improve access to social support networks and improve safety. This could lead to a greater uptake of active means of travel such as walking and cycling (particularly on rural roads with no current footway provision), which could be further encouraged through development of a travel plan/action plans and ongoing monitoring.

3.3.6 Ongoing construction and operation

Potential transport-related health effects during operation will be similar to those identified for the initial construction phase. However, the volume of traffic associated with the GDF is likely to fall compared to the initial construction phase.

As for the initial construction phase, traffic flows arising from staff and visitor transport are currently anticipated to be higher than flows associated with HGVs, perhaps reaching approximately 380 cars per day. There will also be regular movements of radioactive waste to the site. It is assumed that most waste packages will be transported by rail.

It is anticipated that this phase will continue from the initial construction phase and that mitigation and enhancement measures will be put in place during the initial construction phase and will remain in place during operation. Effective and co-ordinated routing, scheduling, traffic management and highway maintenance will help to enhance safety and reduce the risks of accidents, as well as managing potential impacts upon journey amenity and levels of driver stress for the local community.

3.3.7 Closure

As this phase will not take place for more than 100 years, it is difficult to determine with any certainty what transport networks and modes might look like at that time or what related health outcomes there may be.

The likely transport effects of the works to decommission the GDF and restore the site to an agreed end state are uncertain and dependent on the extent to which backfill material is

available from on-site storage and how much material would need to be imported. The closure of the GDF will be subject to detailed assessments at this time, drawing from the evidence base and regulatory regimes set to protect health at that point in time.

3.3.8 Potential health benefits

The GDF presents an opportunity to implement improvements to the local transport network of a host community, with consequent benefits to health and well-being. Community and stakeholder engagement will be critical to exploring and maximising the identification, implementation and uptake of such benefits. Such benefits might include the following.

- Provision of new transport infrastructure that may help to reduce or bypass existing problems such as congestion and road dominance and to improve road safety. This could include new roads, public transport facilities, cycle paths, or footpaths/bridleways.
- Improvements to existing infrastructure, such as roads, footpaths/bridleways and cycle routes/paths and the introduction of traffic management and safety features.
- Development of a travel plan and provision of information to encourage use of active means of travel and alternatives to car use.

Consequent health benefits could include improved physical, social and mental health associated with an increase in walking/cycling/other modes of transport, reduced driver stress on the road network, reduced accident rates and improved access to social support networks.

3.3.9 Future actions

The following actions are recommended.

- A comprehensive community engagement strategy will be developed, to engage with key health stakeholders, local residents and under-represented groups, to inform planning, further inform the scope and focus of technical assessments and explore local community circumstance, priorities, and requirements.
- EIA and other community/site-specific assessments will be undertaken following site selection to include (amongst other technical assessments) an assessment on health effects, including potential effects of transport on communities.
- Potential site-specific impacts from transport communities will be considered within the site selection process and inform the site-specific design of the GDF to reduce potential effects.
- Specific consideration is required for sensitive community groups, including the elderly, infirm, children (including recreational areas and routes to schools) and areas of socio-economic deprivation. This is to ensure that adverse effects on accident rates, journey amenity/stress and social interaction account for disproportionate impacts and are appropriately mitigated.
- A management plan or plans will be provided to manage transport and the social requirements of the workforce to reduce the need for and impact from transport movements on host communities and on rural roads.
- Some form of community liaison group is recommended to facilitate greater input to the design process and to feedback information to local communities (key to addressing risk perception). In this regard, the effects of the GDF on transport infrastructure and the local road network to confirm forecast effects will be monitored and, if necessary, remedial action will be undertaken.

3.4 Access to services and facilities

3.4.1 Overview

This theme covers access to healthcare, education services and facilities and other components of community infrastructure such as community centres and places of worship important to maintaining good social, mental and physical health. It should be read alongside the generic SeA, which considers socio-economic effects in relation to services and infrastructure.

Access to leisure and recreational facilities is considered in Section 3.2.

3.4.2 Potential health outcomes

Figure 7 illustrates factors relating to the accessibility and availability of local services and facilities with the potential to influence health. These include changes in transport (impacting upon community access and accessibility to such facilities) and the introduction of a large workforce to a local community (increasing demand and reducing access to such facilities).

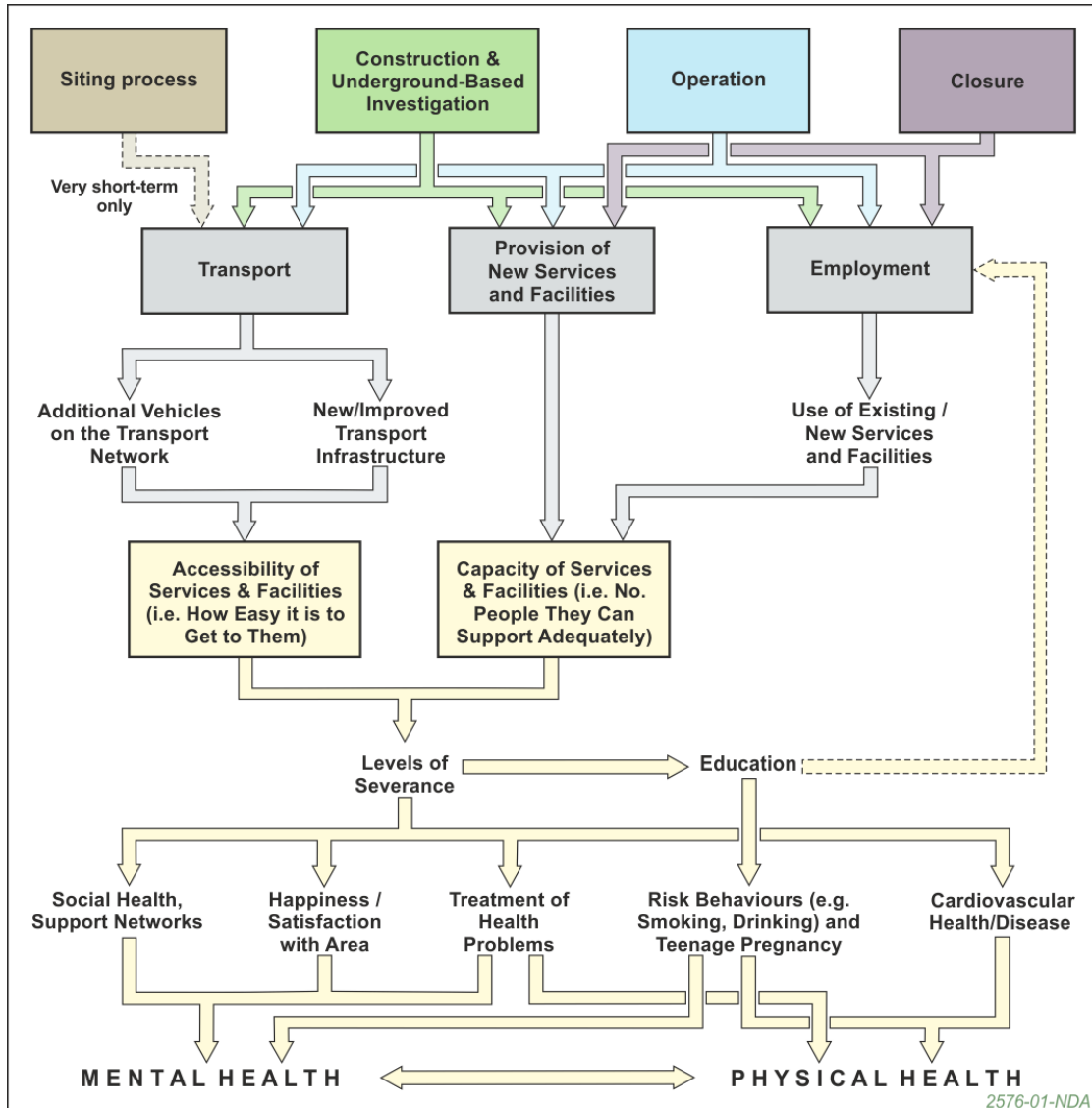
It is particularly important to note that, as with other major infrastructure projects in the UK, the construction workforce is likely to comprise a specific demographic (typically aged 20-50) with an equally specific health care requirement which local facilities may not be able to accommodate (in terms of the additional demographic-specific primary and secondary health care demand).

Equally it is important to note that the construction industry in general typically presents a high rate of occupational injuries requiring emergency care, when compared to all other industries [15], although this is improving. Unmitigated, this can present a risk of increased demand on emergency response services (particularly within rural areas with a wider geographical area to cover), impacting upon capacity but also response times.

Such issues can, however, be internalised through occupational health screening and care to minimise impacts on local services; through comprehensive occupational health and safety to prevent, manage and reduce occupational health risks; and through planning with (and support to) local health care providers and emergency services. An example of this is Hinkley Point C [8], which in turn draws from best practice established during the construction of the 2012 London Olympic Games (albeit in London, with a far greater and overlapping health care capacity, capability and resilience to absorb the health needs of a large construction workforce). Such examples will be drawn upon to inform location-specific assessments, bespoke to local community circumstances, health care capacity and current health care policy.

A third health pathway is associated with the potential introduction of new facilities and services to address the needs of the workforce. While such provision may be primarily to meet the workforce needs, it can also present an opportunity to support and enhance local health care services and capability. Should this option be explored, it is important to consider the location of such provision and enhancement, together with logistics and security. An on-site facility in, or next to, the GDF would minimise time lost and transport movements and would focus upon the main health needs of a specific workforce demographic within a secure location. However, this may not be convenient or cater for the wider health care requirements of a local community.

Figure 7 Generic HIA considerations for access to services and facilities [5]



The ways in which, and extent to which, access to and the availability of community services and facilities will be affected will depend on location-specific issues within individual communities. Therefore, at this generic stage, the generic HIA has focussed on potential effects that might be associated with this theme by phase of the life cycle of the GDF.

3.4.3 Sensitive community groups

Sensitive community groups in this instance can include the elderly, infirm and the socio-economically disadvantaged, that is those with fewer options and coping mechanisms. Some rural communities in particular are sensitive to activities that may impact upon or limit access to services and amenities. This is because availability and accessibility to services may already be limited; with fewer alternatives and less spare capacity than would be found in an urban area.

It is important that these services remain accessible and that forward planning accounts for their effectiveness and demand on capacity. Local population increases associated with the GDF may require additional capacity (and possibly capability) in relevant services and facilities. Measures may also be required to ensure that those communities are not subject

to significant disruption to services that are important to maintaining their health and well-being.

3.4.4 Siting process

During the siting process there will be a limited increase in traffic on the local road network associated with the movement of staff, construction materials and machinery for the borehole programme.

Although such an increase in transport and staff is unlikely to result in any significant adverse effects on the accessibility or capacity of local services and facilities, measures adopted to mitigate any adverse effect might include locating boreholes away from such facilities and services and, where appropriate, small-scale transport infrastructure improvements. Occupational health and safety will apply to minimise risk to workers and prevent effects on local health care and emergency service capacity.

3.4.5 Initial construction and underground-based investigation

The most likely time for adverse effects on access to services and facilities is during the initial construction phase. If the movements of construction traffic and staff travelling to the GDF are not managed effectively, then it is conceivable that a host community's access to services and facilities could be adversely affected. Effects could take the form of increased journey times for residents travelling to use services or facilities, including via public transport, or changes to the transport network resulting in barriers to movement and increased levels of community severance.

The introduction of a large construction workforce (some with dependants) will also increase demand on local services and facilities, alongside the need for accommodation. The latter point in particular will require a strategy to ensure suitable housing for staff, including temporary accommodation (such as hotels, B&Bs, mobile homes, bedsits and construction staff campus). The implementation strategy will need to minimise impacts upon local communities, but also enable them to realise socio-economic benefits (such as rental accommodation, sustenance, recreation and entertainment). Such a strategy will therefore be central to integrating the workforce within a host community. The effects of in-migration on social services are assessed in further detail in the generic SeA.

A variety of measures could be applied to help mitigate adverse effects on health relating to changes in the accessibility and availability of local services and facilities. These will be similar to the transport improvements described under Section 3.3 to reduce congestion on the local road network and to ensure that journey times for residents travelling to use services and facilities are not adversely affected.

Development and implementation of an accommodation strategy and travel plan for the GDF could also encourage staff to utilise alternative modes of travel to car use. This may help to alleviate congestion on the local road network but could also lead to increased demand for public transport services.

In addition to potential increased demand for public transport services, there may also be increased demand on other community services and facilities as a result of any in-migration of the GDF workforce. In particular, it will be necessary to investigate and manage the occupational and public health requirements of construction staff and any dependants (a proportion of staff are likely to bring family). Existing facilities and services will be geared to an area and community and may not have the resources or capacity to accommodate a large, and perhaps more homogenous, construction workforce. On this basis, once a location is identified, it will be critical to engage with key health stakeholders to understand their circumstances and concerns; to work with them to internalise and address the occupational and public health needs of staff; and to coordinate any mitigation or

enhancement measures to address residual effects. This may include, for example, contributions towards local health services.

3.4.6 Ongoing construction and operation

The potential for effects during this phase will be a continuation from the initial construction phase. The volume of traffic on the local road network is likely to fall compared to the initial construction phase. Appropriate routing and scheduling of transport movements, and other traffic management measures, could help to minimise any adverse effects on access to local services.

Demand for services such as housing, education and healthcare will still reflect the needs of a smaller construction workforce, but will also include the operational workforce. It is important to consider that the demographic, behaviour and needs of the construction and operational workforce may be subtly different. Whilst a proportion of construction staff may look to move to an area for long-term employment (particularly where the initial construction phase has a duration of 10 years), some key construction staff tend to work concentrated weeks and will seek basic accommodation during that week before returning home to their families. In contrast, operational staff and their families tend to locate closer to work and are largely a permanent addition to a community, with long-term requirements. The latter may therefore have different housing, education and health care requirements. Further details are provided in the generic SeA, which notes that studies for other facilities have identified a requirement of around one in-patient hospital bed and one staff person for emergency medical services.

Engagement with key stakeholders will be critical to integrating the GDF into local development, infrastructure and service planning; and will ensure existing services and facilities are complemented and remain available for both existing residents and new residents moving to the area. Where appropriate, opportunities to provide new facilities or expand existing facilities for the benefit of the wider community may be explored.

3.4.7 Closure

While it is difficult to predict this far into the future, unless there is some form of diversification, the eventual closure of the GDF could lead to a local economic downturn due to the loss of a major employer in a community, with indirect and induced consequences. This has the potential to impact upon the viability, quality and sustainability of services and facilities in the area. It is likely that the closure of the GDF would be subject to detailed assessments at the time, which are likely to include consideration of effects on local community services and facilities. Given this is a planned phase and the time available to prepare for this, it is anticipated that a strategy would be explored and implemented to support sustainable development, facilities and communities.

3.4.8 Potential for beneficial effects

The GDF presents an opportunity to achieve health benefits within a host community relating to improvements in the accessibility and availability of services and facilities. These could be achieved through improvements to the local transport network or via direct provision of new facilities (for example, health and welfare facilities) or enhancements to existing services and facilities (for example, a contribution towards any increased capacity considered necessary for local hospitals and general practice services) to cater for an influx of new residents to the area.

The existence of the GDF may also generate socio-economic benefits in a host community, leading to further investment in community services and facilities. Finally, the GDF may provide opportunities to improve access to, and improve the capacity and capability of, local services for the wider community.

3.4.9 Future actions

Some or all of the following measures could be adopted to mitigate any adverse effects and to make the most of opportunities for improvement.

- A comprehensive community engagement strategy could be developed, to engage with key health stakeholders, local residents and under-represented groups. This would inform planning, further inform the scope and focus of technical assessments and explore local community circumstances, priorities and requirements.
- EIA and other community/site-specific assessments will be undertaken following site selection to include (amongst other technical assessments) an assessment on health effects, including potential impacts upon community services and amenities. The Hinkley Point C occupational and public health management plan provides a good example of this. The plan seeks to firstly pre-empt and internalise the occupational and public health requirements of staff, provide complementary health care and work with local health care providers to coordinate and direct residual impacts to available and enhanced capacity.
- Potential site-specific impacts on existing facilities and services will be considered within the site selection processes and inform the site-specific design of the GDF to reduce potential effects.
- A management plan or plans could be provided to manage transport and the social requirements of the workforce to reduce the effect on host communities in terms of existing facilities and services. It is equally important to consider long-term construction and operational workers that bring dependants, as this has the potential to generate additional health care requirements for a wider demographic. Engagement with key health stakeholders will be critical to exploring local capacity and enhancing care until NHS budget allocations account for additions to a local population.
- Some form of community liaison group could be established to facilitate greater input to the design process and to feedback information to local communities (key to addressing risk perception).

3.5 Community cohesion

3.5.1 Overview

Community cohesion refers to people's sense of belonging to a community and whether or not the community is considered a social asset. An interpretation of community cohesion, derived from the Centre for Social Relations at Coventry University [16] is that community cohesion is 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

Community cohesion is often central to community physical, mental and social health, where it facilitates strong social and cultural links/values. It also offers additional support

mechanisms and networks, reducing stress, anxiety, perceptions of crime and actual incidence of crime.

This section should be read alongside the generic SeA, which considers the social and economic aspects of community cohesion.

3.5.2 Potential health outcomes

Figure 8 illustrates the activities with the potential to influence community cohesion. As shown below, the primary opportunity to influence health is the level to which communities will participate in, and influence, the siting process to minimise potential effects seen to be a detriment to local values, perceptions and priorities. Conversely, this will also influence how the GDF could complement and enhance local communities and cohesion.

The second factor is direct, indirect and induced income and employment opportunities and associated health benefits. It is important to note, however, that some groups within a host community (for example, those that are retired) may not feel any benefit from employment and may have greater concern in relation to changes in local community structure, lifestyle and disruption.

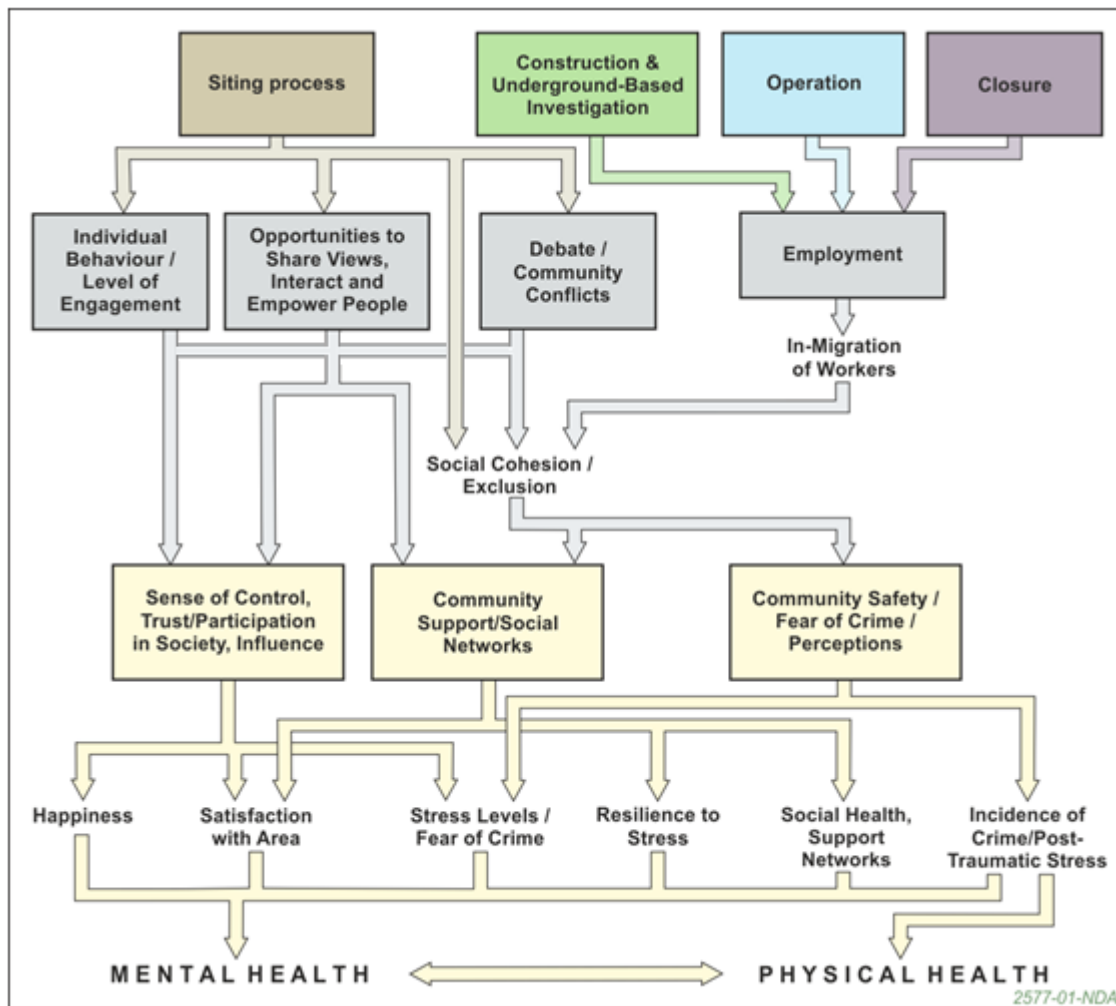
In contrast, young adults eager to stay within an area and maintain social and family networks may place a greater emphasis on the uptake of employment opportunities locally (be they direct, indirect or induced).

Such differing opinions, values and perceptions not only present a challenge to any major infrastructure project, but can also create rifts within a community. Community and stakeholder consultation will therefore be critical to investigating and addressing community concerns and opportunities holistically. Ongoing engagement will be required to rationalise planning preferences and strategies (particularly staff accommodation and management strategies).

The introduction of a large construction workforce within a host community presents a particular set of challenges, where there is often concern for conflicting perceptions, priorities, values and behaviours. Whilst such concerns can often be amplified by drawing upon international examples such as large mining projects [17] [18] [19], examples of major infrastructure projects in the UK (such as Hinkley Point C and the London Olympic Games) demonstrate that planning, including the provision of suitable accommodation and employment strategies, can manage potential impacts upon local communities and community cohesion.

The ways and extent to which community cohesion will be affected will depend on location-specific issues within individual communities. Therefore, at this generic stage, the generic HIA has focussed on potential effects that might be associated with this theme by phase of the life cycle of the GDF.

Figure 8 Generic HIA considerations for community cohesion [5]



3.5.3 Sensitive community groups

It is possible that older/elderly people may feel as though they would 'bear the brunt' of the changes brought about by the GDF and would obtain the least benefit in terms of employment (given their increased likelihood of being retired). This perception may also be affected by the long timescales associated with the GDF and, therefore, the potential timescale over which some of the project benefits would be delivered.

Children can sometimes be particularly fearful of change in their community, given a potential inability to understand information provided, or simple lack of engagement and involvement (as 'spectators' to the process, not 'voters'). Also, some children at the time of a community's participation in the siting process would be adults by the time the construction phase is reached – by the time their community may already be committed to implementing the GDF. This may affect the degree to which they feel engaged with the project.

The ability of particular social groups to engage effectively with debate and decisions about the project may affect levels of community cohesion, with potentially adverse consequences for various aspects of their physical and mental health if there is a lack of effective engagement.

3.5.4 Siting process

During the siting process, ongoing dialogue and debate is likely to create a high level of public interest, which could have a variety of impacts on the mental health and emotional state of a local community, ranging from feelings of excitement and optimism to feelings of mistrust or anxiety. These variations in views towards the GDF may lead to changes in community cohesion.

Adverse effects on community cohesion during this phase of the GDF development are anticipated to be managed at least in part through the nature of the site selection process, which will be undertaken on a voluntary basis. Such effects can be managed and mitigated through implementing a collaborative working approach. This would include all parties involved in developing the GDF actively participating in consultation to align objectives, mitigate any adverse effects and enhance opportunities to support local communities and community cohesion. 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 potential for adverse health effects as a result of implementation of the GDF.

3.5.5 Initial construction and underground-based investigations

During this phase there may be concern about an influx of construction workers and population growth, which could affect communities in the long-term. Adverse health effects relating to community cohesion may occur during construction as individuals within a host community may experience a loss of 'sense of control' over their environment.

Effective integration of new residents (whether they be temporary or longer term) within the host community will be critical. A construction accommodation strategy will be central to this, but also to facilitate effective work patterns. Equally, an employment strategy is recommended to maximise the uptake of employment locally. This is not only beneficial for reducing transport requirements, but would also minimise community impacts and maximise opportunities.

The generic SeA recommends the use of 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 working times) and a community integration plan (for GDF employees relocating to the facility). In addition to this, ongoing engagement through a Community Liaison Group would be recommended to discuss the effectiveness of mitigation and support, and amend where appropriate.

It is envisaged that the developer of the GDF will work closely with the local planning authority and other stakeholders to consider how best to integrate new workers into a local population, including meeting demand for accommodation and community services and managing effects on local development planning.

3.5.6 Ongoing construction and operation

The operation phase will run alongside that of ongoing construction of disposal areas. The operational workforce presents slightly different issues, as they may be more likely to form a permanent and fully integrated addition to a community.

Ongoing monitoring and community engagement will be undertaken to identify any effects relating to community conflict or marginalised groups. Ongoing engagement with the local community will also help to ensure that people are kept informed of any changes at the GDF and that the host community continues to have some influence over operational

aspects of the project (for example, over the timing and routing of HGV movements on the local road network). This would reduce the risk of new adverse effects on community cohesion emerging and allow flexibility to implement changes to mitigation and community support initiatives where appropriate over the prolonged construction and operational phase.

3.5.7 Closure

Adverse effects on the local economy following closure could lead to a range of socio-economic health impacts (stress, anxiety, increased incidence or fear of crime). As this phase is known and scheduled, potential risks will be managed. The final land use at the site will be agreed closer to the time of closure. It is envisaged that this will be explored with local stakeholder and communities closer to the time, thereby accounting for local circumstances and associated values, perceptions and priorities.

3.5.8 Potential for beneficial effects

Effective collaboration between the developer, Government and devolved administrations, the host community and other relevant stakeholders has the potential to support and promote community cohesion during development of the GDF, particularly during its early stages. A comprehensive 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 include a public outreach strategy to address any concerns from the local and broader population. In addition, it could include a group of community and GDF representatives to build on the willingness to participate and liaise with local community leaders about opportunities for community development.

The GDF will result in community investment, which could further help to develop a sense of empowerment within a host community, creating an incentive for local groups and the community as a whole to articulate and promote their needs and aspirations.

3.5.9 Future actions

Some or all of the following measures could be adopted to mitigate any adverse effects and to make the most of opportunities for improvement.

- A comprehensive community engagement strategy could be developed, to engage with key health stakeholders, local residents and under-represented groups, to inform planning, to further inform the scope and focus of technical assessments and explore local community circumstances, priorities and requirements.
- EIA and other community/site-specific assessments will be undertaken following site selection to include (amongst other technical assessments) an assessment on health effects, including potential impacts upon community cohesion.
- Potential site-specific impacts on communities and community cohesion will be considered within the site selection process and inform the site-specific design of the GDF to reduce potential effects.
- Community support initiatives could be explored, including training and education programmes to maximise engagement of the community with the GDF.
- A community liaison group could be established to share monitoring information, review the effectiveness of mitigation and community support initiatives, and where appropriate, supplement or refine such features, thereby retaining community involvement and influence upon the GDF throughout its lifetime.

3.6 Radiological safety

3.6.1 Introduction

Geological disposal will address the safety and security risks inherent in having to maintain and protect surface storage facilities for higher activity waste indefinitely. It will also mitigate risks from societal change, malicious attacks, or climate and environmental change, which could potentially lead to difficulty in managing the waste safely in the very long-term. At a national level, therefore, geological disposal can be seen as a way to significantly reduce the hazard presented by indefinite storage of the waste.

Notwithstanding this national benefit, for a community hosting the GDF the link between radiological safety and potential health effects can be considered in two ways: firstly in terms of exposure to radiation and secondly in terms of fear of exposure to radiation.

Ionising radiation⁷ is naturally present in the environment. Most of this natural radiation comes from radon gas, a product of the radioactive decay of uranium in the earth. Other sources of natural radiation include cosmic rays from space and the presence of naturally occurring radioactive isotopes in food and water. The amount of natural radiation to which a person is exposed varies widely around the world. In the UK the annual average is around 2.2 mSv⁸ but the range across UK counties is between 1.5 mSv and 7 mSv [20]. These levels of natural radiation are very unlikely to cause health problems.

Before the GDF can be constructed and waste emplacement operations commence, regulatory approvals will be needed from the appropriate national authority (Office for Nuclear Regulation or the Secretary of State in Northern Ireland) and regulatory body (the Environment Agency, Natural Resources Wales or the Northern Ireland Environment Agency). To obtain regulatory approval, it will need to be demonstrated, amongst other things, that the radiological risk to individual members of the public and the population as a whole will be as low as reasonably practicable – as well as being within statutory dose limits.

3.6.2 Potential health outcomes

As shown in Figure 9, potential health outcomes fall into two specific categories: actual changes in exposure to radioactive material with the potential to cause harm; and perceived risks, which can impact upon social, mental and physical health through stress and anxiety.

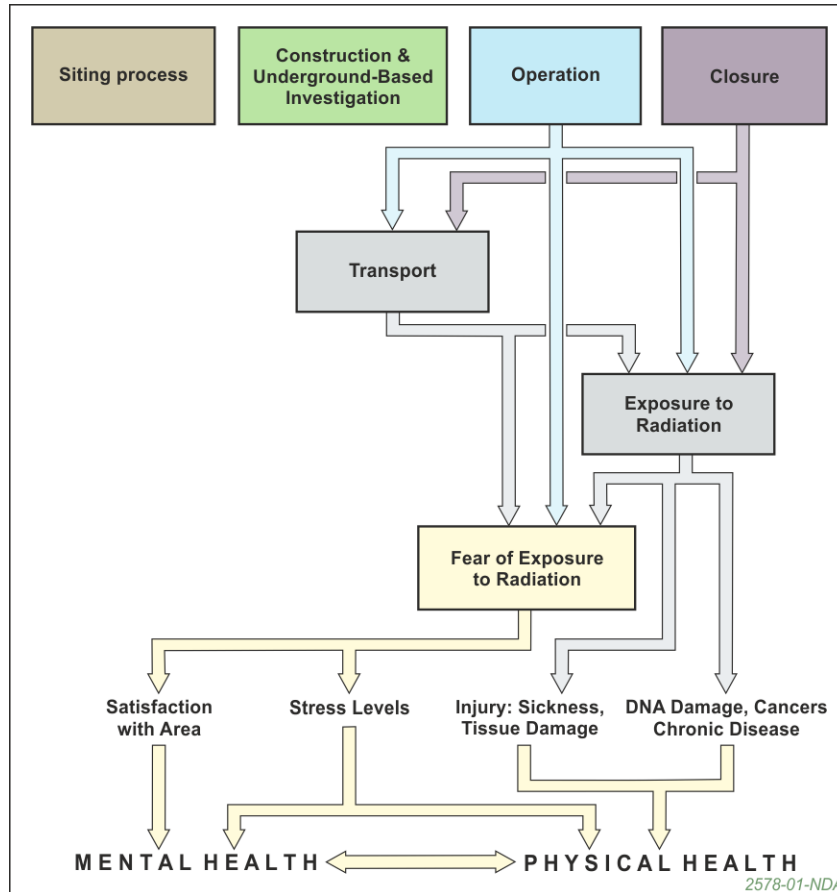
The hazards associated with the former are well known, and are inherently addressed through design, ensuring that additional doses from operation of the GDF are as low as reasonably practicable as well as being within the statutory dose limit of 1 mSv/y specified in the UK Ionising Radiations Regulations. On this basis, there are unlikely to be any measurable adverse health outcomes at such a low additional dose [21] [22].

During the post-closure phase, the radiological risk from the facility to a receptor representative of those at greatest risk will be no greater than the risk guidance level of 10^{-6} per year (this means no greater than a 1 in a million risk of a death or serious hereditary defect to any individual per year). At this level mortality risks are considered to be 'broadly acceptable' [23], [24], posing only a very small addition to the ordinary risks of life.

⁷ Ionising radiation occurs as either waves (such as X-rays and gamma rays) or particles (such as alpha and beta particles). These waves or particles carry enough energy to remove electrons from atoms, causing them to become charged or ionised.

⁸ The Sievert (Sv) is a derived SI unit for ionising radiation. It provides an index for the risk of harm from radiation exposure.

Figure 9 Generic HIA considerations for radiological safety [5]



Following site identification, a bespoke assessment will be commissioned to assess the potential risk associated with the GDF. In reality, the potential risk from the GDF will be lower than the 10^{-6} risk guidance level and is likely to be less than that of current surface storage facilities.

Despite the GDF being specifically designed and operated to manage a known hazard and given that the relative changes in public and occupational exposure are not likely to present a risk to health, there remains the potential for significant health effects related to fear, with associated stress and anxiety. Fear can only be addressed through the factual investigation and dissemination of robust information. Community engagement is therefore critical to investigating and addressing community concerns, together with ongoing engagement through a Community Liaison Group to demonstrate the accuracy of the assessments and the effectiveness of design and mitigation. To demonstrate radiological safety and to obtain the necessary approvals to build and operate the GDF, RWM will produce a detailed safety case covering all aspects of the GDF – the constructed facility, its surrounding environment and the transport infrastructure for moving wastes to the facility. This will be location-specific. However, RWM has already developed a generic safety case (not location-specific) that considers disposal facility designs in a range of different geological environments [1]. This provides confidence that, in due course, a detailed and robust safety case can be made at an appropriately selected site that meets regulatory requirements.

3.6.3 Sensitive community groups

With respect to effects associated with radiation, all groups would be considered to be sensitive. In terms of fear of radiation, there may be differential effects relating to the

degree of understanding of radiological safety and the degree of confidence in geological disposal in different social groups. In part, this may be because some groups are hard to reach and may be unlikely to proactively engage in debate about the subject.

3.6.4 Siting process

During the siting process, there could be adverse health effects within participating communities relating to fear of radiation associated with the later stages of the GDF (if the site is selected). This might be in the form of anxiety or increased stress levels associated with the prospect of living and/or working near the GDF.

To mitigate potential adverse health effects associated with fear of radiation, a pro-active and transparent approach to community engagement on radiological safety will be needed to promote understanding of, and confidence in, the safety of geological disposal. This could help to inform a host community about radiation and the technologies/controls that are used to ensure radiological safety. As well as wider engagement activities, such an approach could include community involvement in safety case development and in the development of monitoring proposals for both the GDF and its surrounding environment. The latter may involve monitoring in potential host communities during the siting process to establish robust baseline data.

3.6.5 Initial construction and underground-based investigation

By the time the construction of the GDF commences, public engagement and information exchange throughout the siting process should have significantly improved local understanding about geological disposal and radiological safety. Any health effects associated with fear of radiation are therefore likely to be reduced, but would require ongoing effort to address unfounded opinions and concerns. This would be best addressed through open and transparent communication and establishment of baseline data to reinforce the effectiveness of design and the commitment to protect the environment and health.

3.6.6 Ongoing construction and operation

The generic Operational Safety Case [25] and the generic Transport Safety Case [26] provide confidence that during normal operations and under potential fault/accident scenarios, the GDF and its associated transport system will meet regulatory requirements set to protect the environment and health, and could be operated safely. For example, the transport containers for radioactive waste are required, under transport regulations, to be able to withstand significant fire and impact challenges and this protection effectively eliminates the consequences that could arise from a large number of potential fault/accident scenarios. Similarly, the GDF will be designed to ensure that, even under very unlikely scenarios, potential radiation doses to members of the public will remain within safe limits. Further information on the criteria applied in assessing the operational safety of the disposal system, for both normal operation and under potential fault/accident scenarios can be found in the generic Operational Safety Case and generic Transport Safety Case.

As for the initial construction period, any health effects associated with fear of radiation may be reduced as a result of improved understanding about geological disposal and radiological safety, but would require ongoing engagement. It is likely that additional information dissemination would be beneficial prior to waste emplacement to ensure continued high levels of understanding and transparency.

During waste emplacement operations, it is anticipated that information relating to ongoing monitoring of the performance of the GDF and of any changes in the local environment would be shared with local communities to help maintain confidence in the safety of the

project. To maximise the benefits of a monitoring programme, key findings of the monitoring should be made available and presented in an easily accessible/understandable format. It may also be beneficial to actively involve the local community in the implementation of a monitoring programme, where appropriate, and to subject monitoring data to regular, independent audit.

3.6.7 Closure

The design of the GDF provides confidence that, once closed, the GDF will safely contain and isolate radioactive waste in the long-term, preventing the release of radioactivity back to the surface environment in quantities that would cause measurable health effects. A generic Post-Closure Safety Assessment [27] includes consideration of the key pathways by which radioactivity might return to the surface environment. These include inadvertent human intrusion, geological events and processes that might disrupt safety barriers and groundwater movement. Further information on post-closure safety can be found in the generic Post-Closure Safety Assessment.

During facility closure, it is likely that any significant health outcomes associated with fear of radiation will be reduced. At this point, the facility will have been a feature of the local community for many years, it is likely that there will be a catalogue of environmental monitoring; and there is likely to be a relatively good understanding of radiological safety and geological disposal. In the longer term, it is difficult to predict the extent to which knowledge of the facility, and any associated health concerns, would persist.

3.6.8 Potential for beneficial effects

As previously discussed, the GDF is designed to provide a long-term, safe solution to radioactive waste management that does not depend on ongoing human intervention. Its benefits particularly include greatly reducing the burden of responsibility from future generations to actively manage the waste; removing the safety and security risks inherent in having to maintain and protect surface storage facilities for this material indefinitely; and mitigating risks from societal changes, climate change or malicious attacks, any of which could lead to significant adverse health effects.

3.6.9 Future actions

Some or all of the following measures could be adopted to mitigate any adverse effects and to make the most of opportunities for improvement.

- A comprehensive community engagement strategy could be developed, to engage with key health stakeholders, local residents and under-represented groups, to inform planning, further inform the scope and focus of technical assessments and disseminate the findings of the radiological assessment.
- EIA and other community/site-specific assessments will be undertaken following site selection to include (amongst other technical assessments) an assessment on health effects, including potential impacts from ionising radiation. A non-technical summary including comparative risk assessment will be provided to aid in addressing community concerns.
- Potential site-specific radiological impacts will be modelled to establish a worst case hypothetical risk to a critical group and to test this against the regulatory requirements.
- A community liaison group could be established to facilitate greater input to the design process and to feedback information to local communities (key to addressing risk perception). Such a group should participate in the development of the monitoring programme; and share monitoring information to address any

residual radiological concerns. Key health stakeholders (for example, the Director of Public Health) could be invited to share routinely collected community health data alongside environmental monitoring data. This would partly be to provide independent expert feedback to the group, but also to explain any changes in disease prevalence that might be misinterpreted as being attributable to the GDF.

- Engagement with the host community during the development of the safety case assessments for the operational and closure phases will be important.

3.7 Environmental effects and health

3.7.1 Overview

Potential environmental impacts upon health are identified in the generic EA. The key effects that may affect health and that are considered within this theme include:

- non-radiological discharges of pollutants, including noise, vibration, light, air pollutants and water pollutants
- the abstraction of water
- changes in land use and land management - including agriculture, flood risk management and management of coastal change

Such potential health impacts are well known and understood, and form the cornerstone of planning and environmental permitting set to protect the environment and health.

3.7.2 Potential health effects

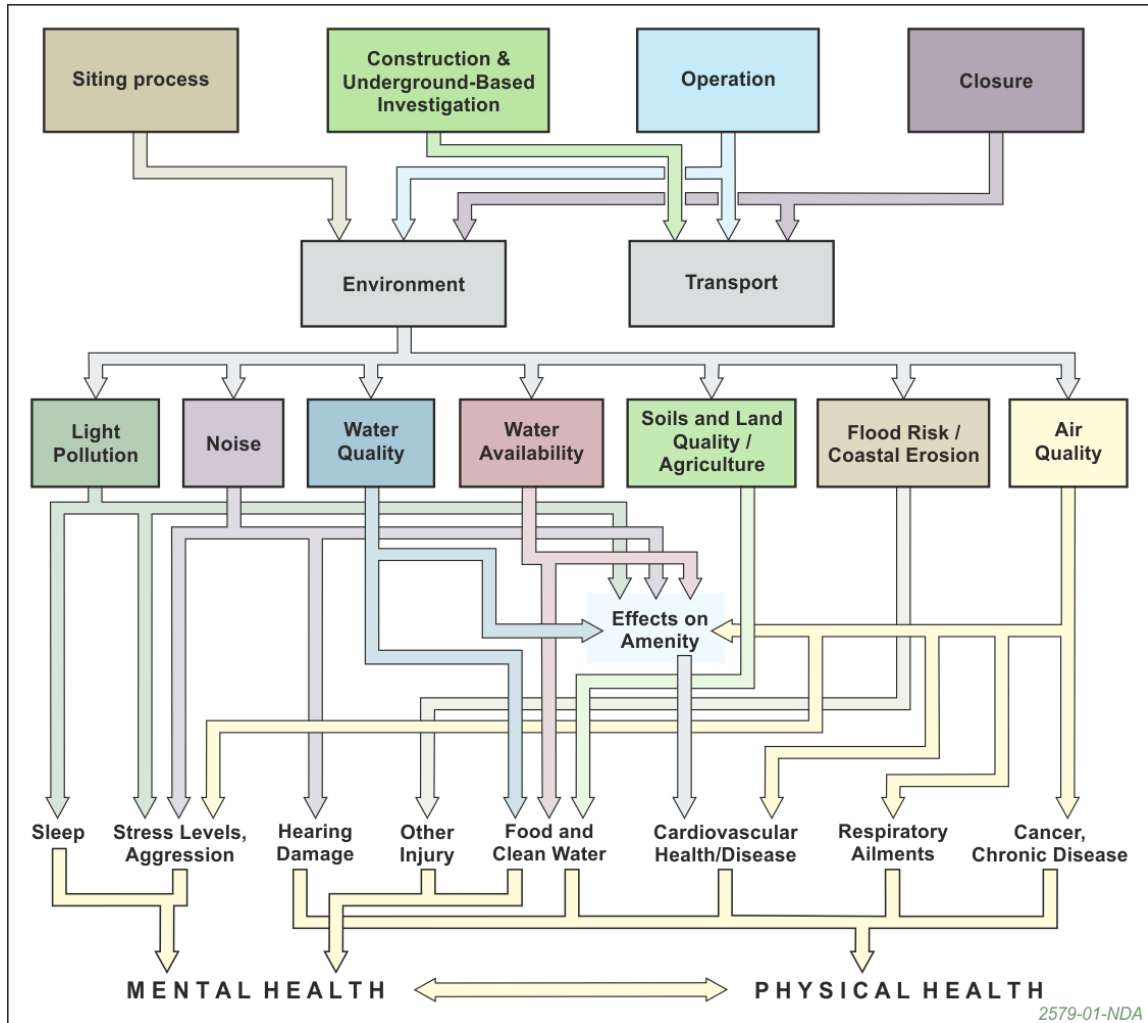
As shown in Figure 10, activities with the potential to influence health include changes to the local environment arising as a result of the life cycle of the GDF and effects related to transport activities.

Such pathways are not, however, exclusive to the GDF, being typical of any large infrastructure project. Such effects are generally addressed through the regulatory process and can be effectively mitigated through proven techniques.

The ways and extent to which the natural environment will be affected will depend on location-specific issues. In turn, this will define the degree of change relative to baseline conditions and the level of exposure of communities to any risk. Therefore, at this generic stage, the generic HIA has focussed on potential effects that might be associated with this theme by phase of the life cycle of the GDF.

This link between environmental effects and health is discussed in Box 1.

Figure 10 Generic HIA considerations for environmental effects and health [5]



Box 1. Environmental Effects and Health

Air Pollution – Research into the potential health effects of air pollutants is extensive and provides statistically significant associations between many air pollutants (for example, particulate matter, nitrogen dioxide and sulphur dioxide) and effects on a wide range of cardiovascular and respiratory health outcomes. Such evidence forms the basis of air quality standards set to protect health [28; 29].

Noise/Vibration – Noise has the potential to affect health in a variety of ways. Community effects are typically associated with exposure to environmental noise, although the pathways and strength of association for these are not fully understood and can vary between individuals. Examples of health effects include [30]:

- annoyance
- mental health
- cardiovascular and physiological
- cognitive performance (tasks and academic)
- night-time effects (sleep disturbance)

Vibration can also be a source of annoyance.

Water Quality and Availability – the water environment can affect drinking water and the quality of ground and surface water. Drinking water quality and quantity can affect health outcomes, whilst impacts on water quality can also affect use for recreational purposes.

Light/Visual – Light pollution and visual impacts may affect the amenity value of areas in which people live, work or undertake recreational/leisure activities.

Soils and Land Quality/Agriculture – A number of studies have shown that food plays an important contributing role in the *'development, management and prevention of specific mental health problems such as depression, schizophrenia, attention deficit hyperactivity disorder, and Alzheimer's disease'* [31].

Flood Risk/Coastal Erosion – Increased flooding can result in a range of effects on health, including effects in relation to stress and the risk of waterborne pathogens.

3.7.3 Sensitive community groups

Sensitivity to the health effects associated with environmental change is generally greatest amongst children, the elderly and those suffering chronic illness. Poor health and/or reduced mobility can make such people more vulnerable and, in economically deprived areas, effects may be exacerbated by restricted choices in terms of avoiding or adapting to environmental change.

3.7.4 Siting process

The siting process will involve drilling a number of boreholes within participating communities to help characterise the local geology. Drilling at each borehole site will last around six months per borehole, but there may be ongoing monitoring at some of these sites. As discussed in the generic EA, borehole site activity will result in temporary environmental effects. Given the relatively small scale and temporary nature of the works at any one location, potential impacts on public health are unlikely to be significant.

Mitigation measures associated with construction could include, for example, locating boreholes away from sensitive environmental receptors and those resources used by the community. Any effects are likely to be relatively minor and could be mitigated through the development and implementation of an Environmental Management Plan, which would include measures for appropriate site restoration once drilling is complete.

3.7.5 Initial construction and underground-based investigation

During this phase of development, there are several potential environmental effects related to the initial construction phase of the GDF, which could influence health. Traffic levels during this initial construction phase are anticipated to be higher than those during the site selection phase or during the ongoing construction/operational phase following first waste emplacement. This has some potential for effects on users of the road network (for example, in relation to accident risk and delay/stress). In addition, it has some potential for effects in relation to air quality and noise associated with traffic levels. Such effects can affect health. For example, changes in community exposure to air pollutants have the potential to influence cardiovascular and respiratory health. Changes in noise exposure have the potential to influence levels of annoyance, but can potentially affect sleep disturbance (a risk factor for cardiovascular disease). The generic EA identifies a range of potential mitigation measures, such as measures to reduce individual car use that could reduce adverse effects. In addition, it is likely that improvements would be made to local transport infrastructure that could, in turn, result in opportunities to address any existing noise or air quality concerns.

The greatest changes in land use (for example, effects on existing landscape, land used by the community, effects on water resources and effects on soils) and visual effects are also likely to occur during the initial construction phase. Deterioration in visual amenity and the loss of habitats and land used for recreation could affect amenity value and discourage physical activity. The combined effect of construction activities and associated disturbance could affect levels of satisfaction with life in the local community and overall well-being. The generic EA identifies opportunities for mitigation through design of the GDF (for example, through provision of screening bunds) and opportunities to provide enhancements (for example, through creation of new landscape features or provision of new land use opportunities).

Following site selection, the GDF will be subject to EIA in support of an application for development consent. The EIA process will identify site-specific environmental and related health effects and define appropriate mitigation measures to avoid any adverse effects or reduce them to an acceptable level. The development of an associated Environmental Management Plan would ensure such mitigation measures are implemented and their effectiveness monitored.

3.7.6 Ongoing construction and operation

Some of the potential effects identified during the initial construction phase may continue into this phase. The main difference will be that any disturbance from surface construction activities will be significantly reduced and effects on land use will be minimal. Mitigation measures such as bunds and planting improvements made during the initial construction phase will become more established and will progressively reduce adverse effects – possibly even improving some aspects of the local environment and provide associated health benefits over time. For example, as screen planting matures, levels of visual amenity will improve and people may be encouraged to make better use of improved recreational areas.

Implementation of an Environmental Management Plan would help to ensure the ongoing effectiveness of mitigation measures and will provide a mechanism for any remedial actions that may be necessary.

3.7.7 Closure

There will be some activities at the GDF associated with closure. However, once the facility has been closed and the surface site restored to an agreed end state, there are unlikely to be any residual adverse health effects. In fact, site restoration would provide an

opportunity to realise local environmental and related health improvements if, for example, the surface site is made available and optimised for local community use.

3.7.8 Potential for beneficial effects

The GDF will present opportunities for environmental (and related health) improvements within a host community. These are likely to be location-specific and their realisation will, to a large extent, depend on the aspirations and priorities of the local community. Further details are provided in the generic EA.

3.7.9 Future actions

Some or all of the following measures could be adopted to mitigate any adverse effects and to make the most of opportunities for improvement.

- A comprehensive community engagement strategy could be developed, to engage with key health stakeholders, local residents and under-represented groups to inform planning and the scope and focus of the public health section, to more effectively investigate and address community concerns.
- EIA and other community/site-specific assessments will be undertaken following site selection to include (amongst other technical assessments) an assessment on health effects.
- To address risk perception, a monitoring programme could be established, and the findings shared and discussed with the Community Liaison Group to validate the findings of the EIA process and the effectiveness of mitigation and community support initiatives.

3.8 Socio-economics and health

3.8.1 Overview

Employment and income are potentially the most significant socio-economic determinants of long-term health, influencing a range of factors including the quality of housing, education, diet, lifestyle, coping skills, access to services and social networks.

Poor economic circumstances can influence health throughout life, where communities subject to socio-economic deprivation are more likely to suffer from morbidity, injury, mental anxiety and depression and tend to suffer from higher rates of premature death than those less deprived [32; 33; 34].

Changes in employment and income can have a number of influences on people's health. In studies of long-term trends, being employed has been shown to lower the probability of suffering impaired mental health [35] and is linked with greater physical health, such as lower rates of heart disease and other chronic diseases [36; 37]. Studies have also identified that low income can lead to poor health, and vice versa [38].

People who are unemployed are more than twice as likely to be at risk of suffering mental illness as people in employment [39]. According to a policy paper by the Mental Health Economics European Network, *'Employment can have two distinct effects on mental health. It can be protective: individuals value the opportunities offered by employment and this helps to keep them well. It also provides social status and identity, a sense of achievement and a means of structuring one's time'* [35].

The Marmot Review of 2010 (a major study into the link between inequality and health) found that in England, people living in the most deprived neighbourhoods have an average life expectancy seven years less than people living in the most affluent neighbourhoods.

On average, people on low incomes have 17 fewer years of disability-free life than people on high incomes [38].

The causal links between unemployment/low income and adverse health effects are thought to include lower living standards and poorer health behaviours such as smoking, alcohol consumption, poor diet and reduced exercise. Unemployment and low income can also act as triggers for distress, anxiety and depression (such as loss of core role in the family, loss of a sense of identity and loss of rewards, social participation and support).

The potential socio-economic effects of the GDF are outlined in Box 2. Further detail can be found in the generic SeA Report.

Box 2. Socio-economic effects

The generic SeA Report indicates that the GDF may result in as many as 500-700 new jobs being available at a local (District) level, as an annual average over the lifetime of the facility. Most of these will be secure, long-term jobs for a range of skilled workers and technicians. They will include people directly employed in the planning, construction, operation and eventual closure of the facility; additional jobs supported in the local supply chain; and additional jobs that will result from increased spending in the wider economy. Moreover, depending on the socio-economic profile of the host community and the implementation of initiatives to support development of the local economy, the economic benefit at a local (District) level could be up to approximately £8 billion (undiscounted) over the project lifetime.

The socio-economic analysis also indicates that the average annual spend from business tourism associated with the construction and operation of the GDF may be between £6.7m and £13.3m. However, there could be adverse effects on the UK leisure tourism industry.

A literature review indicated there may be a small adverse effect on property values very close to the GDF. It is also possible that some adverse effects may be felt during the siting process. However, effects are likely to be very location-specific, and will depend on the characteristics of the local property market and on the local community's perception of risk from the GDF.

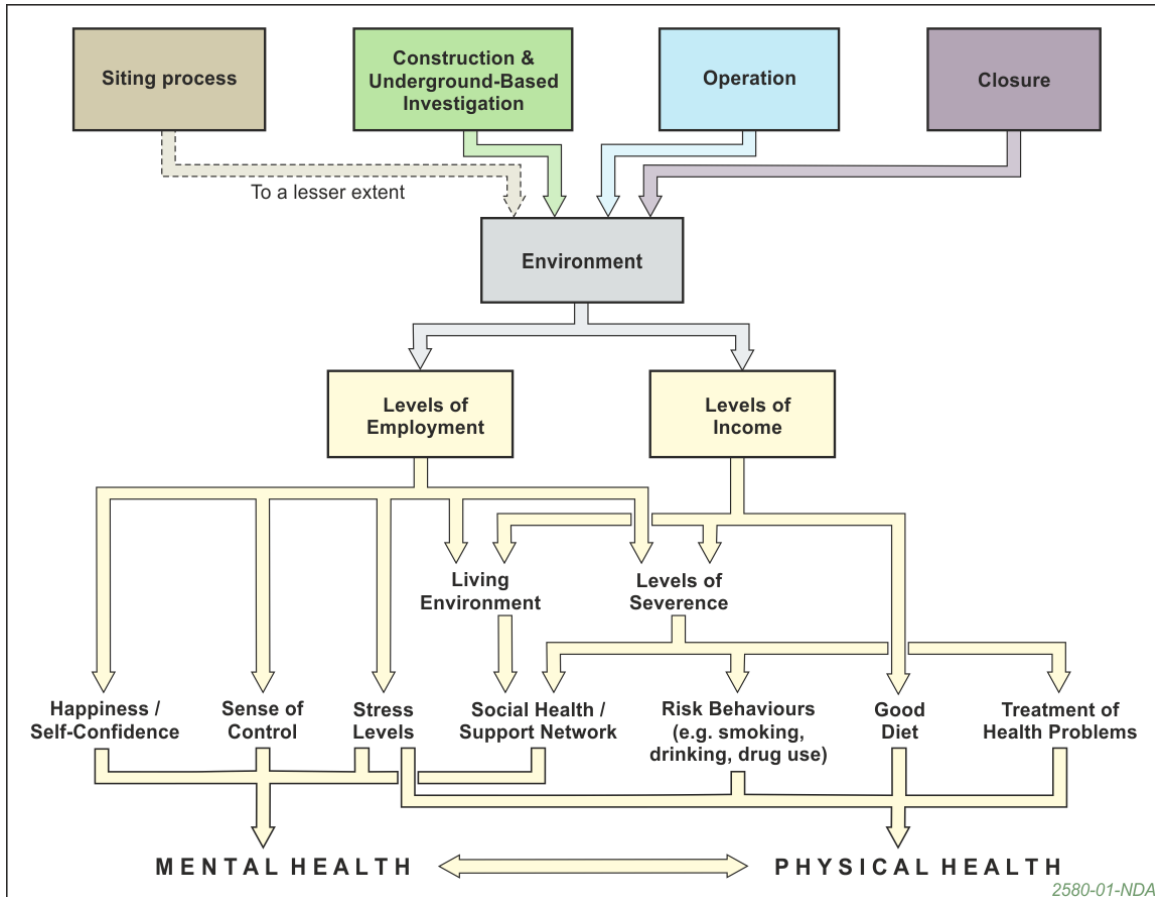
The generic SeA suggests a number of mitigation and enhancement measures that could help to ensure the local community makes the most of the socio-economic opportunities presented by the GDF.

3.8.2 Potential health outcomes

As shown in Figure 11, the socio-economic characteristics of a host community could be affected by the development of the GDF through:

- employment opportunities supported by the GDF or its associated activities
- changes in employment conditions for the community, including local businesses
- economic development locally, community investment and future development

The ways and extent to which levels of income, employment opportunities and the local economy will change and influence community and individual health will largely depend on the characteristics of a host community. Therefore, at this generic stage, the generic HIA has focussed on potential effects that might be associated with this theme by phase of the life cycle of the GDF.

Figure 11 Generic HIA considerations for socio-economics and health [5]

3.8.3 Sensitive community groups

In considering the effects of socio-economic change on health and well-being, the following groups are likely to be the most sensitive.

- **Elderly:** Health tends to be more sensitive in general to change of income (for example, in relation to fuel poverty⁹), which in turn may cause changes to health and well-being. In addition, the elderly may be supported by family or carers who are at least part-time employed, and thus their care may change alongside changes in overall employment and income in the community. By proportion of households, fuel poverty is highest in Northern Ireland, followed by Wales (nearly double that of England) and then the east and west midlands of England [40].
- **Children:** May be particularly sensitive to change in employment status or income of parents or guardians. Regionally, child poverty is highest in the north east of England, followed by the north west, west midlands and Wales. Concentrations of higher child poverty often correlate with areas of above 4.5% unemployment [41].
- **Groups suffering a level of inequality due to disability, gender, ethnicity/nationality or sexual orientation:** For these groups, there may be potential for differential effects through unequal distribution of/access to socio-economic benefits.

In general, those most economically deprived in society are often the most vulnerable and least able to cope with adverse socio-economic effects. Conversely they may also benefit

⁹ Fuel poverty (or the state of being 'fuel poor') is often defined as the situation where a household needs to spend more than 10% of its income on fuel in order to maintain an adequate level of warmth.

most from socio-economic improvements. The generic SeA concludes that the majority of income generated by implementation of the GDF is likely to be received by lower-income groups in the local community.

3.8.4 Siting process

The GDF will significantly enhance the socio-economic well-being of a host community. The 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. To help anchor potential socio-economic benefits in the local community and to ensure they reflect community aspirations and have an enduring impact, such investment will be linked to socio-economic assessments undertaken by the developer during the siting process. The assessments could, for example, identify a need to invest in education and skills programmes to remove barriers to local uptake.

During the siting process the developer will work with potential host communities, helping them to identify and articulate their aspirations for sustainable community development. This process of engagement would help to ensure that a host community makes the most of the socio-economic opportunities provided through the project and through additional Government and devolved administrations investment. Although the overall socio-economic effects are expected to be positive, there is the potential for some adverse effects, notably on property prices and leisure tourism. Such effects are associated with changed perceptions of an area as a place to live, work or invest and could be manifest during the siting process. These effects could, in turn, lead to increased levels of anxiety and stress in the local community.

In the event that potential adverse effects on property prices becomes a significant concern, consideration would be given to implementing a property value protection plan to compensate property owners for any losses associated with a decrease in value, rental income or associated mortgages attributable to the GDF. Such an initiative should be effective in reducing associated levels of anxiety and stress and could be implemented during the siting process. Further details are provided in the generic SeA.

Mitigation measures that could be considered to address effects on leisure, tourism and inward investment include promotional campaigns to raise the profile of an area as a place to visit and invest; and effective local engagement to promote a good understanding of geological disposal and the opportunities it presents for sustainable community development.

3.8.5 Initial construction and underground-based investigations

Construction of the GDF will be a multi-billion pound project, providing direct employment. There will also be indirect and induced opportunities associated with investment in infrastructure and the development of local service industries that will support the facility and its workforce – in terms of additional jobs and economic investment.

Direct employment is expected to peak during this phase. There will also be beneficial multiplier effects as workers migrate into the area and increase demand for local services and facilities.

Integration of new residents within the host community will be an important consideration, to minimise disruption and to promote community cohesion. As set out in the community cohesion theme, it is envisaged that the developer would work with the local community to consider how best to integrate new workers, including meeting demand for accommodation and community services, and managing effects on local development planning.

The mitigation measures outlined for the siting process to address potentially adverse effects on property prices, leisure tourism and inward investment should enable such effects to be avoided altogether or reduced to acceptable levels. Notwithstanding such

measures, the net socio-economic effect is likely to be positive with associated benefits for community health and well-being.

3.8.6 Ongoing construction and operation

During the operational phase, socio-economic and associated health effects are likely to be similar in nature to those during the initial construction phase. Direct employment levels will drop from the peak construction level, but it is anticipated that the GDF will support approximately 500-600 new full time equivalent jobs in an average year throughout the life time of the facility. Measures will be implemented to seek to maximise the uptake of employment locally; and as time goes by 'new' staff are likely to become fully integrated into the local community. Further details are provided in the generic SeA report.

Ongoing monitoring could be undertaken to track socio-economic effects during facility operation, to confirm the effectiveness of associated mitigation and enhancement measures and, if necessary, to inform the refinement of mitigation and community support initiatives.

3.8.7 Closure

Adverse effects on the local economy associated with loss of jobs and an economic downturn following closure of the GDF could lead to adverse health effects. It is likely that the closure and decommissioning of the GDF would be subject to detailed assessments at the time, which are likely to include consideration of socio-economic and associated health effects. As this phase is known and scheduled, it is likely that opportunities to agree an appropriate end use for the site would be explored with local stakeholder and communities closer to the time, thereby accounting for local circumstances and associated values, perceptions and priorities.

3.8.8 Potential for beneficial effects

The generic SeA concludes that, on balance, there is likely to be a significant net economic benefit for a host community. The positive economic development and employment effects are likely to outweigh any adverse effects on tourism and property values, particularly given the potential to minimise adverse effects through initiatives to promote the host community as a place to live, work, visit and invest. As illustrated in Figure 11, people who benefit from more reliable employment and better income are likely to experience improved mental and physical health. Further details regarding employment are provided in the generic SeA.

3.8.9 Future actions

Some or all of the following measures could be adopted to mitigate any adverse effects and to make the most of opportunities for improvement.

- Potential site-specific socio-economic impacts will be investigated, assessed and addressed through the regulatory assessment process set to protect the environment and health.
- A community and site-specific assessment could be carried out during the siting process, to include (amongst other technical sections) consideration of public health. This could draw from and build upon the socio-economic assessment to explore local circumstance and needs that can be addressed through design and support initiatives to remove potential impacts and maximise the uptake of benefits locally.
- A comprehensive community engagement strategy could be developed, to engage with key health stakeholders, local residents and under-represented groups, to

inform planning and the scope and focus of public health, to more effectively investigate and address community circumstances, concerns and requirements.

- A series of training and employment initiatives would help to remove barriers that might limit the uptake of income and employment opportunities locally. Construction training programmes could be offered to maximise the uptake of local and regional employment opportunities. Accommodation and staff management strategies need to account for local priorities, and where possible, strike an appropriate balance that minimises community disruption, maximises worker efficiency and safety and retains economic benefits for host communities. Given the temporal nature of the project, vocational graduate and post graduate schemes can also be offered locally to train operational staff for the lifetime of the project. This not only maximises the uptake of local benefits and minimises transport impacts, but also aids in communities retaining young adults and maintaining social and family networks (particularly in rural communities).
- Training and employment monitoring data could be shared and discussed with the host community over the lifetime of the project. Where appropriate, support initiatives would be modified or refined to address changes in local requirements and barriers to the uptake of opportunities. The host community could also contribute towards the development of a final land use and diversification strategy to manage the potential risk of economic downturn as the facility closes, and to maximise future opportunities.

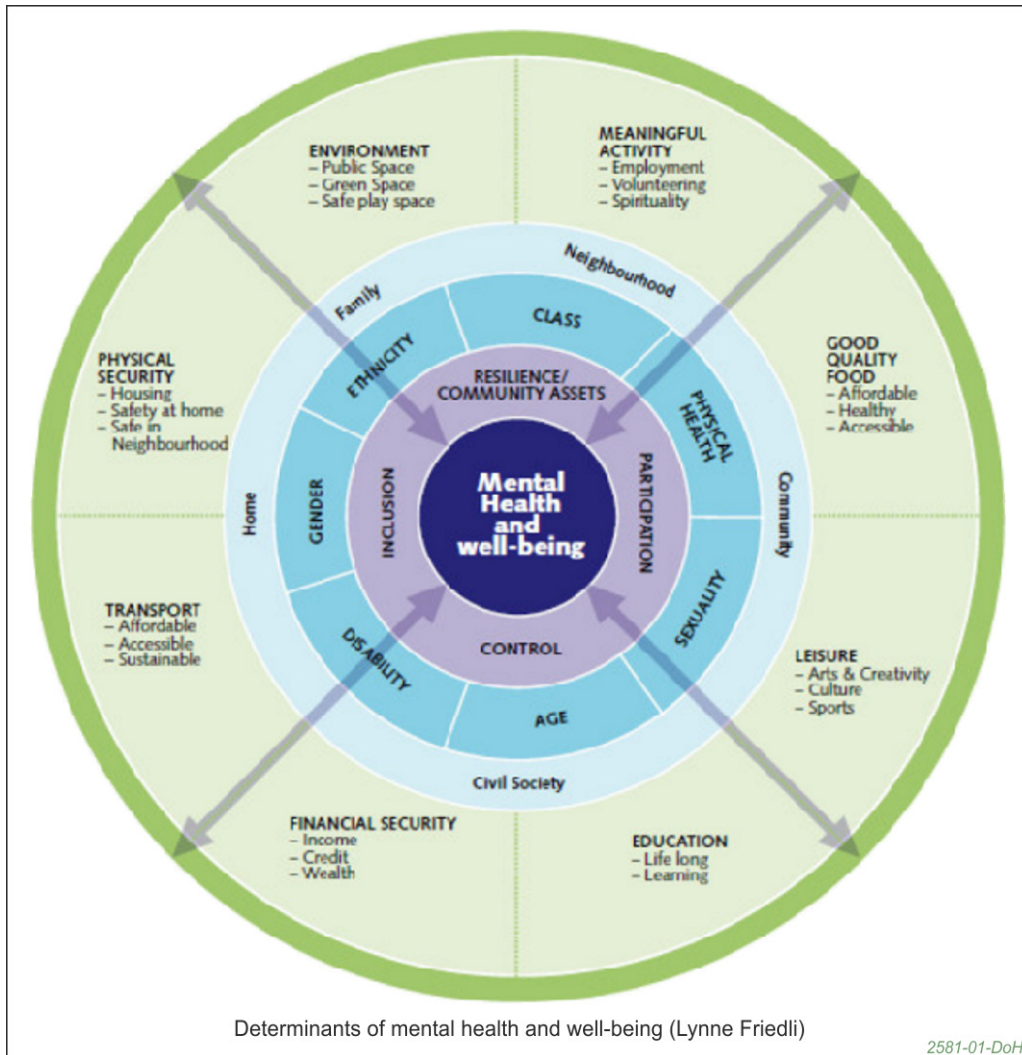
3.9 Combined health and well-being effects

This section draws together the potential mental and physical health and well-being effects identified under each of the seven key themes considered in Sections 3.2 to 3.8.

Mental health problems can interfere with an individual's quality of life, prevent them performing social roles effectively (including normal 'home life' and community roles) and inhibit their attainment of skills. They can also have an adverse effect on an individual's ability to obtain and maintain employment, as they may be unable to perform certain tasks or undertake certain activities.

The process of HIA is focused on determinants to overall health and well-being, with a subset of determinants used to assess mental health and well-being, as shown in Figure 12.

Figure 12 The determinants of mental health and well-being according to guidance by the Mental Well-being Impact Assessment (MWIA) Collaborative [42]



Mental health and well-being within a participating community could be adversely affected during the siting process. There are various determinants of mental health and well-being which a proposal for a controversial project such as the GDF could affect, largely through people's perceptions of an area as a place to live and work. People may, for example, be worried about aspects of their physical and financial security such as property values and inward investment. However, the UK Government and devolved administrations are committed to a transparent and collaborative siting process and to working closely with potential host communities to understand and address their concerns and aspirations. This would include providing information on the potential effects of geological disposal so that people understand what the GDF might mean for them. This would include effective dissemination of information, including for example educational sessions for schools and involving local communities in the development of detailed proposals for implementation, including appropriate mitigation where necessary. Such measures would help to build understanding of and confidence in the project, minimising levels of anxiety and any adverse effects on mental health.

Consideration should be given during the siting process to the role of online communication, such as websites and groups and the effect that these have on risk perception, mental health and well-being. For example specific groups can easily be set

up, in both support and opposition of the GDF facility and their messages and concerns can quickly and easily be made available to the community through online media. This could have the potential for considerable stress and well-being effects from perception of risk, if information was to be inaccurately presented to communities. In order to mitigate this risk and to address inaccurate perceptions surrounding radiological safety and other potential issues, it is suggested that RWM or the community set up an online group forum or social media group to present evidence to support the messages that they report, in an attempt to alleviate concerns regarding risk and perceptions of risk.

During the initial stages of construction, there are similar concerns about potential effects on individuals or communities close to the GDF. As well as ongoing concerns about property values and inward investment, people may be worried about adverse effects on community cohesion and related issues such as crime levels. Fear of radiation may also increase levels of anxiety and stress. However, with ongoing involvement of the community in the project and the progressive realisation of tangible employment and economic benefits, the net effect on mental health is likely to be positive.

During operation, as the facility becomes a more accepted feature of the local area and confidence in its safe operation grows, positive mental health effects are likely to continue.

It is envisaged that the final end-state of the site following closure would be explored with local stakeholders and the host community closer to the time, thereby accounting for local circumstances at that point, and associated values, perceptions and priorities.

The net effect on people's physical health across various groups and locations, generation-by-generation, as a result of the range of potential effects identified under the seven key themes considered is difficult to assess with certainty at this generic stage.

This is largely because many effects will be dependent on location and because people's interactions with their community and environment are complex and subject to change (including habits and behaviours).

Across the seven themes, a wide range of potential health pathways and well-being effects have been identified.

At a local level, the GDF seems likely to result in net physical health benefits due to factors such as improved infrastructure, services and facilities, employment opportunities, increased economic development and associated mental health benefits. However, effects on health issues vary by theme, and actual effects will depend on the location chosen for the GDF and the detailed development of implementation proposals for that location (including availability of opportunities for improvements and enhancements and the degree to which these are taken forward).

At a national level, the overall health effects of developing the GDF are also likely to be positive, when compared to the assumed baseline situation of ongoing surface storage of radioactive waste. Geological disposal has been selected as a long-term, safe solution to radioactive waste management that removes the safety and security risks inherent in having to maintain and protect surface storage facilities indefinitely. It mitigates long-term risks from potential societal change, climate change or malicious attacks, any of which could lead to a failure to manage the waste safely.

4 Next Steps

4.1 Assessment work during the siting process

During the siting process for the GDF, the Government and RWM will work with participating communities to identify potential candidate sites and, ultimately, a preferred site for a disposal facility. It is anticipated that location-specific assessment work will be undertaken to inform this process, building on the generic assessment work, including this generic HIA.

The drilling of boreholes during the siting work will be subject to a development consent process. Any development consent application for boreholes is likely to be supported by an EIA, which will include consideration of health issues. The actions listed in this generic HIA should be carried across into the EIA process at this stage, and explored through a bespoke assessment considering local environmental and community circumstances.

Any subsequent development consent application for the GDF will also be accompanied by an EIA, including further assessment of health impacts.

A number of recommendations regarding future actions are set out in Section 3 above. These will be taken into consideration where appropriate, during future stages of assessment.

4.2 Monitoring and managing effects on health and well-being

Mitigation and monitoring will form a key component to addressing community concerns, and monitoring will assist in validating the accuracy of the assessments, design features and mitigation set to protect the environment and health. Given the life cycle of the GDF, a baseline and comprehensive monitoring programme will be required, as will some form of community liaison group to share and discuss the findings, and where appropriate refine or enhance mitigation and support initiatives to address changes in local circumstance, priorities and needs.

It is important to note that given the multidisciplinary nature of health, monitoring should focus on environmental and socio-economic key performance indicators directly attributable to the proposed GDF, including those that would be clearly linked to health outcomes. This may include, for example, monitoring of air quality, noise and traffic flows.

References

- 1 Radioactive Waste Management, *Geological Disposal: Overview of the Generic Disposal System Safety Case*, DSSC/101/01, 2016.
- 2 Department of Energy and Climate Change, *Implementing Geological Disposal – A framework for the long term management of higher activity waste*, URN 14D/235, July 2014.
- 3 Radioactive Waste Management, *Geological Disposal: Technical Background to the generic Disposal System Safety Case*, DSSC/421/01, 2016.
- 4 Radioactive Waste Management, *Geological Disposal: Derived Inventory Report*, DSSC/403/01, 2016.
- 5 Radioactive Waste Management, *Geological Disposal: Generic Health Impact Assessment*. RWM Document Number 22161106, 2014.
- 6 Radioactive Waste Management, *Geological Disposal: Generic Socio-economic Assessment*, DSSC/333/01, 2016.
- 7 Radioactive Waste Management, *Geological Disposal: Generic Environmental Assessment*, DSSC/331/01, 2016.
- 8 EDF Energy, *Hinkley Point C, Development Consent Order Application, Health Impact Assessment*, Ref 8.15, October 2011.
- 9 NDA, *Geological Disposal: A proposed approach to Equality Impact Assessment*, NDA Technical Note no.16093875, January 2012.
- 10 U.S. National Library of Medicine, *Exercise and immunity*, <https://medlineplus.gov>, 2015.
- 11 National Health Service, *Benefits of exercise*, <http://www.nhs.uk>, 2015.
- 12 U.S. National Library of Medicine, *Benefits of regular exercise*, <https://medlineplus.gov>, 2014.
- 13 Littman, T., *Economic Value of Walkability*, Transportation Research Record: Journal of the Transportation Research Board, 1828 3-11, 2003.
- 14 Department of Health & Department for Transport, *Transport and Health Resource: Delivering Healthy Local Transport Plans*, January 2011.
- 15 Health and Safety Executive, *Industry injury rates based on annual average estimates for 2012/13-2014/15*.
- 16 Centre for Social Relations at Coventry University, *Policy Framework*, <http://www.cohesioninstitute.org.uk>, 2013
- 17 McMahon, G. & Remy, F. (eds), *Large Mines and the Community – Socioeconomic and Environmental Effects in Latin America, Canada, and Spain*, ISBN 0-88936-949-6, January 2001.
- 18 Rolfe, J., Lockie, S. & Franettovich, M., *Economic and Social Impacts of the Coppabella Mine on the Nebo Shire and the Mackay Region*, Central Queensland University report to Australian Premium Coals Pty Ltd, April 2003.
- 19 Beattie, L, Eversole, R, Krummel, S & Walcott, G., *From shearing stands to stripping sands: sustainable regional development and mining industry startup in established agricultural communities*, Proceedings of the Conference: '2005 Minerals Council of

- Australia Sustainable Development Conference: People, Place and Prosperity', Alice Springs (Australia), 31 October – 4 November 2005.
- 20 Public Health England, *Ionising Radiation Exposure of the UK Population: 2005 Review*, HPA-RPD-001, May 2005.
 - 21 Public Health England, *An Introduction to the Estimation of Risks Arising from Exposure to Low Doses of Ionising Radiation*, HPA-RPD-055, June 2009.
 - 22 Public Health England, *Ionising radiation: dose comparisons*, March 2011.
 - 23 Health and Safety Executive, *The Tolerability of Risk from Nuclear Power Stations*, ISBN 0118863681, October 1992.
 - 24 Health and Safety Executive, *Reducing Risks, Protecting People*, ISBN 0717621510, 2001.
 - 25 Radioactive Waste Management, *Geological Disposal: Generic Operational Safety Case Main Report*, DSSC/202/01, 2016.
 - 26 Radioactive Waste Management, *Geological Disposal: Generic Transport Safety Case Main Report*, DSSC/201/01, 2016.
 - 27 Radioactive Waste Management, *Geological Disposal: Generic Post-closure Safety Assessment report*, DSSC/321/01, 2016.
 - 28 Public Health England, *Long-Term Exposure to Air Pollution: Effect on Mortality, A report by the Committee on the Medical Effects of Air Pollutants*, ISBN 978-0-85951-640-2, June 2009.
 - 29 Public Health England, *The Mortality Effects of Long Term Exposure to Particulate Air Pollution in the United Kingdom, A report by the Committee on the Medical Effects of Air Pollutants*, ISBN 978-0-85951-685-3, December 2010.
 - 30 Health Protection Agency, *Environmental Noise and Health in the UK: A report by the ad hoc expert group on noise and health*, ISBN 978-0-85951-668-6, 2010.
 - 31 Mental Health Foundation, *Diet and Mental Health*, www.mentalhealth.org.uk, 2015.
 - 32 Béland, F., Birch, S., and Stoddart, G., *Unemployment and Health: contextual-level influences on the production of health in populations*, Social Science & Medicine 55 (11) 2033-52, December 2002.
 - 33 Stafford, M., Martikainen, P., Lahelma, E. & Marmot, M., *Neighbourhoods and self rated health: A comparison of public sector employees in London and Helsinki*, Journal of Epidemiology and Community Health 58 (9) 772-8, January 2004.
 - 34 Van Lenthe, F. J., Borrell, L. N., Costa, G., Diez-Roux, A. V., Kauppinen, T. M., Marinacci, C., Martikainen, P., Regidor, E., Stafford, M. & Valkonen, T., *Neighbourhood unemployment and all cause mortality: a comparison of six countries*, Journal of Epidemiology and Community Health 59 (3) 231-7, July 2004.
 - 35 Mental Health Economics European Network, *Employment and mental health: Assessing the economic impact and the case for intervention*, ISBN 978-0-85328-237-2, January 2008.
 - 36 Jin, R. L., Shah, C. P. & Svoboda, T. J., *The impact of unemployment on health: a review of the evidence*, Canadian Medical Association Journal 153 (5) 529-40, September 1995.

- 37 Alavinia, S. M. & Burdorf, A., *Unemployment and retirement and ill-health: a cross-sectional analysis across European countries*, International Archives of Occupational and Environmental Health 82 (1) 39-45, February 2008.
- 38 Marmot, M., *Fair Society, Healthy Lives: The Marmot Review: strategic review of health inequalities in England post-2010*, ISBN 9780956487001, February 2010.
- 39 The Poverty Site, *Mental health*, <http://www.poverty.org.uk>, 2011.
- 40 Department of Energy and Climate Change, *Fuel poverty report: annual report on statistics 2013*, May 2013.
- 41 End Child Poverty, *Child Poverty Map of the UK*, Centre for Research in Social Policy, Loughborough University report to End Child Poverty, October 2014.
- 42 National MWIA Collaborative (England), *Mental Well-being Impact Assessment: A toolkit for well-being*, May 2011.

Glossary

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

Appendix A – Detailed Methodology for the Generic HIA

A1 Relevant Guide Documents and Key Steps in the Generic HIA

Key formal guidance on HIA includes the following:

- Department of Health: Draft Guidance on Health in Strategic Environmental Assessment Consultation Document (2007) [1]
- NHS, Health Development Agency: Introducing health impact assessment (HIA): Informing the decision-making process (2002) [2]
- National MWIA Collaborative (England): Mental Well-being Impact Assessment: A toolkit for well-being (2011) [3]
- World Health Organisation: a range of online material including a 'Tools and Methods' section, which provides guidance on how to conduct HIA (<http://www.who.int/hia/tools/process/en/index.html>) [4]
- International Association for Impact Assessment: Health Impact Assessment: International Best Practice Principles (2006) [5]
- West Midland Public Health Observatory: More than a statement of the crushingly obvious: A critical guide to HIA (2007) [6]

The above guidance is complementary, setting out a consistent progression of tasks and providing a range of advice at varying levels of detail for conducting an HIA. As there is no pre-eminent guide to HIA, recent developments in theory and practice have been drawn upon where applicable. This approach has been determined in line with relevant practitioner knowledge and experience, and with reference to other examples of HIA in the UK.

The HIA process is commonly broken down into four to six stages.

- **Scoping** involves identifying what to do and how to do it, including whether or not to conduct HIA, and the level of detail required. Scoping sets the boundaries of a HIA, such as geographical extent, population groups considered, identification of vulnerable receptors and the timescale over which to predict health effects.
- **Assessment** involves identifying and scaling health effects in accordance with the scoping, and making appropriate recommendations. This involves compilation and extension of evidence collected during the scoping stages. Making recommendations is important to mitigate potential adverse health effects and enhance health benefits arising from a plan, programme or development project. This builds on the information discussed within the assessment sections and looks at what additional measures could be taken beyond those already included within the proposals which are the subject of the HIA, both to address adverse health effects and suggest enhancements to achieve health benefits.
- **Reporting** involves summarising the process and results of an HIA in a report.
- **Monitoring** occurs after adoption of a plan, programme or development project. It fulfils any monitoring recommendations from the assessment stage, and helps to enhance the existing evidence base. It can also allow unforeseen health effects to be identified at an early stage, and enable remedial action to be taken, if necessary.

The HIA process is intended to be iterative, so that each stage can, if required, be revisited as a result of further development of the project implementation process and with the

emergence of new information. For this generic HIA, this is expected to occur through subsequent, community and site-specific HIAs.

A2 Key Considerations of the Generic HIA

The subject of the generic HIA was based on the generic GDF designs and generic transport system designs. Also, the generic HIA was developed whilst bearing the following in mind:

- NDA, A proposed approach to Equality Impact Assessment, January 2012 [7]
- the current status of the siting process, with no specific GDF host community on which to base an assessment
- the need to inform the future implementation of geological disposal, including the siting process site characterisation work, the development of detailed proposals for a preferred site, and the construction, operation and closure of a disposal facility
- uncertainty related to generic design, including the waste inventory to be managed, the host rock and depth for the facility, and the generic transport design (for example choice of transport mode)
- the extensive background knowledge within the NDA / RWM and elsewhere regarding geological disposal, such as reports regarding radiological safety (for example the generic disposal system safety case), and the need to tie these into a coherent argument for various health and well-being topics
- the relationship of the generic HIA with the other generic assessments (generic EA, generic SeA)
- the practicalities of delivering the GDF over a long timescale, and the need to develop an effective action plan to take this work forward

A3 Scoping

Within its published Strategy for Sustainability Appraisal and Environmental Assessment [8], RWM undertook to carry out an assessment of potential effects on health and well-being as part of the implementation process for geological disposal.

The generic HIA was initiated with a review of queries and concerns about health and well-being effects related to geological disposal. The focus of this review was documentation of the UK's GDF siting programme to-date in order to identify the key health and well-being-related concerns about geological disposal expressed by stakeholders, including the public. The key health concerns identified are summarised in Table A1 below.

Table A1 Key health issues expressed previously by stakeholders and the public involved in the MRWS process

Issue of Relevance	Stakeholders' negative perceptions / concerns	Some key positive perceptions
Level of confidence in regulatory regime	<p>Good mental health is linked with a sense of understanding and influence over your immediate environment. The review uncovered an issue around fear and uncertainty such as:</p> <ul style="list-style-type: none"> • People expressed suspicion / mistrust of proposals related to nuclear / radioactive waste • Doubts in regulators' resources and capability to properly oversee geological disposal • Doubts over ability to adequately assess long-term safety (science) 	<p>In contrast to negative perceptions, members of participating councils expressed confidence in the regulatory regime (for example expertise, staff capacity). Regulators themselves were also confident in their abilities and the regulatory framework they enforced.</p>
Effects on Socio-economics	<p>Good health is linked with stable employment and income. Related to this, the following observations of people's concerns are relevant:</p> <ul style="list-style-type: none"> • Concerns that the image of the host area could be damaged, having effects on tourism and exports (for example farms/foods), and causing planning blight • Concerns that job creation may be minimal in the long-term, and that locals may not get the good jobs • Concerns around changes in income distribution. 	<p>Stakeholders recognised that the GDF could lead to job creation.</p>
Transport issues	<p>Stakeholders expressed concerns about:</p> <ul style="list-style-type: none"> • Noise, vibration and air pollution • Congestion, road traffic accidents and accident / terrorist attack to transported radioactive waste • Release of radioactivity during transport 	<p>Some stakeholders expressed confidence in the proposed siting process, regulators and future Safety Case for the GDF.</p>
Effects on the capacity and or quality of services and facilities	<p>Good health is linked to better access to services and facilities in the community:</p> <ul style="list-style-type: none"> • Concerns about capacity of services due to increased workers and potential population 	<p>Stakeholders recognised the GDF could lead to the development of infrastructure, services and facilities.</p>
Effect on the social cohesion	<ul style="list-style-type: none"> • Concerns about social / residency issues (for example change in social character, and having incomers who are not committed to the area) 	<p>Stakeholders recognised that the GDF could empower the community instead by opening up doors to new ideas by deciding on how the community would proceed going forward.</p>

Issue of Relevance	Stakeholders' negative perceptions / concerns	Some key positive perceptions
Long-term safety	Stakeholders expressed concerns about: <ul style="list-style-type: none"> • Release of radioactivity during operation and beyond • Fear of the GDF's potential susceptibility to such changes in geology as seismic events and hydraulic fracturing for onshore gas extraction ('fracking') 	In contrast to negative perceptions, members of participating councils recognised the potential for geological disposal to store radioactive waste safely.
Environmental effects	Stakeholders expressed concerns about: <ul style="list-style-type: none"> • Pollution of the water environment • Loss of land / land use and amenity • Effects on views from the surrounding area / landscape and visual environment 	Some stakeholders expressed confidence in the proposed siting process, regulators and future Safety Case for the GDF.

A scoping exercise was then conducted to identify the generic pathways for potential effects from the GDF on health and well-being. It was based on theoretical links, with no consideration of the likely significance of these pathways at this stage. This was a preliminary analysis and was subject to review by relevant health experts outside the generic HIA team. As this is a generic assessment, all potential issues were considered. However, it is important to note that some issues may be more important to stakeholders than other issues. For a community or site-specific assessment, this would become clear during the scoping stage and through discussions with key stakeholders.

This generic pathways analysis was conducted on the basis of the determinants of health. In order to achieve robust coverage of potential pathways whilst minimising overlap of issues, the determinants were re-named and consolidated into the following:

The determinants of health and guidelines used to identify them:

- Lifestyle – Essential Services (Adapted from Dahlgren & Whitehead, 1991) [9]
- Lifestyle – Recreational & Physical Activity (Adapted from Barton & Grant, 2006) [10]
- Personal and Physical Security (Adapted from Friedli, 2011)
- Social & Community Networks (Dahlgren & Whitehead, 1991)
- Psychological Factors (Friedli, 2011)
- Local Economy & Economic Activity (Adapted from Barton & Grant, 2006)
- Built Environment (Barton & Grant, 2006)
- Natural Environment – Air, Water and Land (Adapted from Barton & Grant, 2006)
- Natural Environment – Access & Education (Adapted from Barton & Grant, 2006)
- Global Ecosystem (Barton & Grant, 2006)

The scoping exercise identified many issues which are consistent with the review of stakeholder feedback. Combined with that review, it resulted in the following broad issues being identified, which may have a bearing on health and well-being.

- Individuals' work/life balance (for example changes to lifestyle / quality of life, in making time or perceiving the need / compulsion to make time, to be engaged in consultations or even opposition movements), including possible benefits against

the future baseline of potential multiple proposed projects for long-term surface storage

- The effects on capacity and/or quality of services and facilities from an in-migration of staff / workers, including the benefits of investment potentially attracted either directly from the GDF or via the spent tax and income of employed staff / workers, or the potential adverse effect of this investment not adequately compensating for the additional demand for services
- The capacity and/or quality of healthcare as a result of changes to fear of radiation exposure (potential to affect fear of illness/hypochondria), including potential net reduction in fear relative to long-term surface storage at multiple sites
- The capacity and/or quality of services and facilities from closure and resulting out-migration of people (staff / workers and descendants of them), including either residual improvements, or sudden loss of trade / investment
- Personal and physical security or fear of health effects through exposure to radiation (including as could result from accidents or terrorist attack), including potential improvements against the baseline of long-term surface storage
- Personal and physical security or fear of health effects through electricity connection / pylons and electromagnetic radiation, or potential reduction if existing pylons are an issue and can be consolidated, moved or given a design upgrade to support the power demands of the GDF
- Change to the risk of accidents either at work sites from construction of the GDF or associated infrastructure, or on the transport network from changes in transport infrastructure or demand due to the GDF
- Stress / anxiety / uncertainty and 'sense of control' in dealing with the long-term presence of radioactive waste nearby
- Stress / anxiety / uncertainty as a result of specific sources, such as construction, operation, closure or post-closure (various specific sources, including fear of exposure to radiation, in turn from various sources of potential exposure – for example transport, facility, water / soil, seismic activity) – again, this may also be a reduction as compared to the future baseline scenario of long-term surface storage and multiple projects around the country
- Crime or fear of crime (for example resulting from in-migration of staff / workers)
- Spaces, buildings or other areas hosting community services, recreational facilities, natural areas / habitats and community centres
- Access to community services, recreational facilities, natural areas / habitats and community centres
- Image / branding of an area, including potential positive effects at locations where surface storage is decommissioned
- Property value / planning blight, including again the potential positive effects at locations where surface storage is decommissioned
- Economic development generally – locally, regionally
- Existing business uses of land (for example agriculture / farming)
- Built or natural features which contribute to a community's sense of identity
- Community cohesion as a result of incomer / 'outsider' differences of perspective (both in decisions about the GDF and in ongoing local decision-making on other issues)

- Water quality
- Landscape and visual amenity
- Water availability (for example via abstraction licenses or via changes in demand on existing abstraction sources)
- Flood risk locally, from changes to impermeable areas
- Ecosystems (for example via radioactivity or physical development effects), such that the quality and attractiveness of recreation / physical activity is altered
- Townscape / sense of place and amenity of the built environment
- The global ecosystem (for example biodiversity, climate change)

The potential issues were grouped under key themes, which are as follows.

- **Recreation, amenity and physical activity:** considers issues that affect land areas used directly for recreation; paths, National Cycle Network, and long-distance footpaths; land areas or sites used indirectly for recreation, historic assets and features, and other visitor attractions used for local recreation; and visual environment / landscape
- **Transport and health:** limited to issues affecting travel / accessibility, with other effects identified under other topics (for example noise, air quality, land use / amenity, well-being)
- **Access to community services and facilities:** addresses the capacity of, and access to, essential and important services and facilities relative to health
- **Community cohesion:** addresses this important health issue, including community identity and sense of belonging, relative to potential changes to the local population and influences on decision-making
- **Radiological safety:** limited to effects on people (not food, water or wildlife). Whilst this topic would otherwise fit under 'physical health and well-being', the level of importance of this issue (to stakeholders in particular) makes it appropriate to address on its own
- **Environmental effects and health:** covers non-radiological discharges of pollutants, including noise, vibration, light, air pollutants and water pollutants; the abstraction of water; and the location of the GDF relative to existing and future uses and changes to the land, including agriculture, flood risk and coastal change
- **Socio-economics effects and health:** limited to issues focused on economically geared activities, including education, but also general investment in communities (some unavoidable overlap with services and facilities)

A4 Assessment

A desk-based assessment was conducted, considering (at a generic level) the latest information about how geological disposal might be implemented. This was determined through reviewing a range of generic designs reflecting implementation in different types of host rock in the UK: higher strength rock, lower strength rock and evaporite rock as described in the NDA reports, Geological Disposal: Technical Background to the Generic Disposal System Safety Case [11] and Geological Disposal: Generic Transport System Design [12].

Key activities in implementing geological disposal which could influence human health were then highlighted and reviewed. The potential 'pathways' for effects on people's health and

well-being were then reviewed extensively and iteratively through several rounds of assessment. As part of this process, the generic HIA considered potential measures which might be used to mitigate and manage potential adverse health effects, and also to achieve health benefits. A combination of experience in HIA and professional judgement was used in determining the likelihood of significant health effects with those mitigation and management measures in place.

A4.1 Potentially vulnerable groups

Within the study area, certain groups of people may be more or less sensitive / vulnerable to the potential health effects of geological disposal (see Table A2). The assessment work considered the potential for differential effects on such groups.

Table A2 Sensitive / vulnerable groups

Equalities Area	Group	Vulnerability to Health Effects
Age	Elderly	Poor health and/or reduced mobility can render this group more vulnerable to virtually any health impacts which affect their lives, including in particular impacts on the accessibility of services and on their areas of residence (for example nearby amenity impacts or noise / vibration effects).
	Children	Child poverty is a key issue in the UK, and impacts on employment and income often affect children more than adults. Reliance on adults for mobility can render this group more vulnerable to impacts on local recreation, pedestrian and cycle accessibility.
Disability	Disabled people and those suffering a long-term illness (including mental illness)	As for the elderly, poor health and/or reduced mobility can render this group more vulnerable to virtually any health impacts which affect their lives, including in particular impacts on the accessibility of services and on their areas of residence (for example nearby amenity impacts or noise / vibration effects). Access to healthcare and essential services is of key concern.
Gender reassignment	Gay, lesbian, bisexual and transsexual communities	Issues to do with development often affect these groups very similarly, and so they are considered together. May be more vulnerable to impacts which affect community access and safety (for example safety on public transport, crime rates overall).
Sexual orientation		
Sex, pregnancy and maternity	Pregnant women and young mothers	Potentially more vulnerable to secondary impacts on recreation and mental health. Pregnant women and women who have recently given birth are susceptible to anxiety and depression, with resultant adverse consequences to both themselves and their foetus or child. Obesity in pregnancy is associated with increased risk of nearly all birth complications, and therefore access to quality recreation is of key importance to this group [13].
Ethnicity and nationality	Minority ethnic groups or nationalities	Different groups may be more susceptible to various impacts on health. For example, any groups who experience regular and more active discrimination may be more susceptible to impacts which affect community access and safety. Certain groups may be linked to lower income levels for various socio-economic reasons, and therefore be affected disproportionately by any impacts on the local economy.
Religion or belief	Any religion or belief	Development can potentially have impacts on places of worship or locations of cultural significance.
Socio-economics	Economically deprived communities	Socio-economics has a key link with health in the population. Communities suffering high rates of unemployment and low income may suffer disproportionate health impacts if adversely affected.

References for Appendices

- 1 Department of Health (DoH), *Draft Guidance on Health in Strategic Environmental Assessment, Consultation Document*, March 2007.
- 2 NHS Health Development Agency, *Introducing health impact assessment (HIA): Informing the decision-making process*, 2002.
- 3 National MWIA Collaborative (England), *Mental Well-being Impact Assessment: A toolkit for well-being*, May 2011.
- 4 World Health Organisation (WHO), HIA, *Tools and Methods*, <http://www.who.int>
- 5 International Association for Impact Assessment, *Health Impact Assessment: International Best Practice Principles*, September 2006.
- 6 West Midland Public Health Observatory, *More than a statement of the crushingly obvious: A critical guide to HIA*, October 2007.
- 7 NDA, *Geological Disposal: A Proposed Approach to Equality Impact Assessment*, NDA Technical Note No 13824468, January 2012.
- 8 NDA, *Geological Disposal: A Strategy for Sustainability Appraisal and Environmental Assessment*, NDA/RWMD/014, July 2009.
- 9 Dahlgren, G. & Whitehead, M., *Policies and Strategies to Promote Equity in Health, Background document to WHO – Strategy paper for Europe*, ISBN: 9789185619184, September 1991.
- 10 Barton, H. & Grant, M., *A health map for the local human habitat*, Journal of the Royal Society for the Promotion of Public Health, 126 (6) 252-61, November 2006.
- 11 Radioactive Waste Management, *Geological Disposal: Technical Background to the Generic Disposal System Safety Case*, DSSC/421/01, 2016.
- 12 Radioactive Waste Management, *Geological Disposal: Generic Transport System Design*, DSSC/411/01, 2016.



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