

Public Health England

Advice on the content of Environmental Statements accompanying an application under the Nationally Significant Infrastructure Planning Regime

About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. We do this through world-leading science, research, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. We are an executive agency of the Department of Health and Social Care, and a distinct delivery organisation with operational autonomy. We provide government, local government, the NHS, Parliament, industry and the public with evidence-based professional, scientific and delivery expertise and support.

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Executive summary

Introduction

The purpose of this document is to help applicants understand the issues that PHE expect to see addressed by applicants preparing an Environmental Statement (ES) as part of their Nationally Significant Infrastructure Planning (NSIP) submission.

We have included a comprehensive outline of the type of issues we would expect to be considered as part of an NSIP which falls under the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations). PHE encourages applicants to contact us as early in the process as possible if they wish to discuss or clarify any matters relating to chemical, poison, radiation or wider public health and wellbeing.

We work closely with public health professionals in Wales, Scotland and Northern Ireland, and internationally.¹ We have specialist teams advising on specific issues and the potential impacts arising from environmental public health including chemicals, noise, air quality, ionising and non-ionising radiation.

PHE's NSIP roles and responsibilities

PHE is a statutory consultee in the NSIP process for any *applications likely to involve chemicals, poisons or radiation which could potentially cause harm to people and are likely to affect significantly public health.*² PHE will consider potential significant effects (direct and indirect) of a proposed development on population and human health and the impacts from chemicals, radiation and environmental hazards. We also consider other factors which may have an impact on public health, such as the wider determinants of health, health improvement and health inequalities (where PHE has a legal duty specified in the Health and Social Care Act 2012)³.

Under certain circumstances PHE may provide comments on radiation on behalf of the Scottish Government. If a proposer is submitting a planning application in Scotland which may require advice on radiation you are recommended to contact the appropriate Scottish Planning Authority for advice on how to proceed.

In the case of applications in Wales, PHE remains a statutory consultee but the regime applies to a more limited range of development types. For NSIP applications likely to affect land in Wales, an applicant should still consult PHE but, additionally will be required to consult the Welsh Government.

Environmental Impact Assessments – PHE's Responsibilities

PHE has a statutory role as a consultation body under the EIA Regulations. Where an applicant has requested a scoping opinion from the Planning Inspectorate⁴, PHE will be

¹ <https://www.gov.uk/government/organisations/public-health-england/about#priorities>

² The Infrastructure Planning (Interested Parties and Miscellaneous Prescribed Provisions) Regulations 2015

³ <http://www.legislation.gov.uk/ukpga/2012/7/contents/enacted>

⁴ The scoping process is administered and undertaken by the Planning Inspectorate on behalf of the Secretary of State

consulted regarding the scope, and level of detail, of the information to be provided in the ES. PHE has a duty to make information available to the applicant.

PHE provides advice relating to EIA within this document and during the NSIP consultation stages. PHE encourages applicants to discuss the scope of the ES with us at an early stage to explore, for example, whether careful site selection or other design issues could minimise or eliminate public health impacts or to outline the requirement for, scope and methodology of any assessments related to public health. PHE's standard recommendations in response to EIA scoping consultations are below.

General Approach

PHE provides advice relating to EIA within this document and during the NSIP consultation stages. It is the role of the applicant to prepare the ES.

When preparing an ES the applicant should give consideration to best practice guidance such as the Government's Handbook for scoping projects: environmental impact assessment⁵, and Guidance: on Environmental Impact Assessment⁶

The **Planning Inspectorate's Advice Note Seven**: Environmental Impact Assessment: Process, Preliminary Environmental Information and Environmental Statements also provide guidance to applicants and other persons with interest in the EIA process as it relates to NSIPs. It is important that the submitted ES identifies and assesses the potential public health impacts of the activities at, and emissions from, the development.

Applicants are reminded that Section 5(2)(a) of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 specifically includes a requirement that the EIA must identify, describe and assess in an appropriate manner, in light of each individual case, the direct and indirect significant effects of the proposed development on population and human health.

PHE is of the opinion that this requirement encompasses the wider determinants of public health, as well as chemicals, poisons and radiation. Further information on PHE's recommendations and requirements is included below.

PHE understands that there may be separate sections of the ES covering the assessment of impacts on air, land, water and so on, but expects an ES to include a specific section summarising potential impacts on population and health. This section should bring together and interpret the information from other assessments as necessary. The health, wellbeing and population impacts section should address the following steps.

- Screening: Identify any significant effects.
 - Summarise the methodologies used to identify health impacts, assess significance and sources of information
 - Evaluate any reference standards used in carrying out the assessment and in evaluating health impacts (e.g., environmental quality standards)
 - Where the applicant proposes the 'scoping out' of any effects a clear rationale and justification should be provided along with any supporting evidence.

⁵ <https://www.gov.uk/government/publications/handbook-for-scoping-projects-environmental-impact-assessment>

⁶ <https://www.gov.uk/guidance/environmental-impact-assessment#the-purpose-of-environmental-impact-assessment>

- **Baseline Survey:**
 - Identify information needed and available, evaluate quality and applicability of available information
 - Undertake assessment (additional guidance on the assessment of Health and Wellbeing requirements is included in the appendix).

 - **Alternatives:**
 - Consideration of alternatives (including alternative sites, choice of process, and the phasing of construction) is widely regarded as good practice. Ideally, the EIA process should start at the stage of site selection, so that the environmental merits of practicable alternatives can be properly considered. Where this is undertaken, the main alternatives considered should be outlined in the ES⁷.

 - **Impact Prediction: Quantify and Assess Impacts**
 - Evaluate and assess the extent of any positive and negative effects of the development. Effects should be assessed in terms of likely health outcomes, including those relating to the wider determinants of health such as socio-economic outcomes, in addition to health outcomes resulting from exposure to environmental hazards. Mental health and wellbeing should be included and given equivalent weighting to physical effects.
 - Clearly identify any omissions, uncertainties and dependencies (eg, air quality assessments being dependant on the accuracy of traffic predictions)
 - Evaluate short-term impacts associated with the construction and development phase
 - Evaluate long-term impacts associated with the operation of the development
 - Evaluate any impacts associated with decommissioning of the development
 - Evaluate any potential cumulative impacts as a result of the development, currently approved developments which have yet to be constructed, and proposed developments which do not currently have development consent

 - **Design and assess possible mitigation:**
 - Consider and propose suitable corrective actions should mitigation measures not perform as effectively predicted.

 - **Monitoring and Audit:**
-

⁷ DCLG guidance, 1999 <http://www.communities.gov.uk/documents/planningandbuilding/pdf/155958.pdf>

- Identify key modelling predictions and mitigation impacts and consider implementing monitoring and audit to assess their accuracy / effectiveness.

Any assessments undertaken to inform the ES should be proportionate to the potential impacts of the proposal, therefore we accept that, in some circumstances particular assessments may not be relevant to an application, or that an assessment may be adequately completed using a qualitative rather than quantitative methodology. In cases where this decision is made, the applicant should fully explain and justify their rationale in the submitted documentation.

Human and environmental receptors

The applicant should clearly identify the development's location and the distance of the development to off-site receptors that may be affected by emissions from, or activities at, the development. Off-site receptors may include people living in residential premises; people working in commercial, and industrial premises and people using transport infrastructure (such as roads and railways), recreational areas, and publicly-accessible land.

Identify and consider impacts on residential areas and sensitive receptors (such as schools, nursing homes and healthcare facilities, as well as other vulnerable population groups such as those who are young, older, with disabilities or long-term conditions, or on low incomes) in the area(s) which may be affected by emissions, this should include consideration of any new receptors arising from future development

Consideration should also be given to environmental receptors such as the surrounding land, watercourses, surface and groundwater, and drinking water supplies such as wells, boreholes and water abstraction points.

Impacts arising from construction and decommissioning

Any assessment of impacts arising from emissions or activities due to construction and decommissioning should consider potential impacts on all receptors and describe monitoring and mitigation during these phases. Construction and decommissioning will be associated with vehicle movements and cumulative impacts should be accounted for.

We would expect the applicant to follow best practice guidance during all phases from construction to decommissioning to ensure appropriate measures are in place to mitigate any potential negative impact on health from emissions (point source, fugitive and traffic-related) and activities. An effective Construction Environmental Management Plan (CEMP) (and Decommissioning Environmental Management Plan (DEMP)) will help provide reassurance that activities are well managed. The applicant should ensure that there are robust mechanisms in place to respond to any complaints made during construction, operation, and decommissioning of the facility.

Chemicals, Poisons and Radiation

Emissions to air and water

PHE has a number of comments regarding the assessment of emissions from any type of development in order that the ES provides a comprehensive assessment of potential impacts.

When considering a baseline (of existing environmental quality) and in the assessment and future monitoring of impacts these should:

- include an evaluation of the public health **benefits** of development options which reduce air pollution – even below limit values – as pollutants such as nitrogen dioxide and particulate matter show no threshold below which health effects do not occur.⁸⁹
- consider the construction, operational, and decommissioning phases
- consider the typical operational emissions and emissions from start-up, shut-down, abnormal operation and accidents when assessing potential impacts and include an assessment of worst-case impacts
- fully account for fugitive emissions
- include appropriate estimates of background levels
 - when assessing the human health risk of a chemical emitted from a facility or operation, background exposure to the chemical from other sources should be taken into account
- encompass the combined impacts of all pollutants which may be emitted by the development with all pollutants arising from associated development and transport, considered in a single holistic assessment (ie, of overall impacts)
- identify and consider impacts on residential areas and sensitive receptors (such as schools, nursing homes and healthcare facilities) in the area(s) which may be affected by emissions. This should include consideration of any new receptors arising from future development
- identify cumulative and incremental impacts (ie, assess cumulative impacts from multiple sources), including those arising from associated development, other existing and proposed development in the local area, and new vehicle movements associated with the proposed development; associated transport emissions should include consideration of non-road impacts (ie, rail, sea, and air)

⁸ <https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution>

⁹

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/795185/Review_of_interventions_to_improve_air_quality.pdf

- compare predicted environmental concentrations to the applicable standard or guideline value for the affected medium. Where available, the most recent UK standards for the appropriate media (ie, air, water, and/or soil) and health-based guideline values should be used when quantifying the risk to human health from chemical pollutants
- where UK standards or guideline values are not available, use those recommended by the World Health Organization or other reputable International bodies eg EU or OECD
 - If no standard or guideline value exists, the predicted exposure to humans should be estimated and compared to an appropriate health-based value (eg, a Tolerable Daily Intake or equivalent)
 - This should consider all applicable routes of exposure (eg, include consideration of aspects such as the deposition of chemicals emitted to air and their uptake via ingestion)
- include appropriate screening assessments and detailed dispersion modelling where this is screened as necessary
- include Chemical Abstract Service (CAS) numbers alongside chemical names, where referenced in the ES
- include consideration of local authority, Environment Agency, Natural Resources Wales, Defra national network, and any other local site-specific sources of monitoring data
- when quantitatively assessing the health risk of genotoxic and carcinogenic chemical pollutants, PHE does not favour the use of mathematical models to extrapolate from high dose levels used in animal carcinogenicity studies to well below the observed region of a dose-response relationship. When only animal data are available, we recommend that the Committee on Carcinogenicity of Chemicals approach¹⁰ is used

Whilst screening of impacts using qualitative methodologies is common practice (eg, for impacts arising from fugitive emissions such as dust), where it is possible to undertake a quantitative assessment of impacts then this should be undertaken.

PHE's view is that the applicant should appraise and describe the measures that will be used to control both point source and fugitive emissions and demonstrate that standards, guideline values or health-based values will not be exceeded due to emissions from the installation, as described above. This should include consideration of any emitted pollutants for which there are no set emission limits. When assessing the potential impact of a proposed installation on environmental quality, predicted environmental concentrations should be compared to the permitted concentrations in the affected media; this should include both standards for short and long-term exposure. Further to assessments of compliance with limit values, for non-threshold pollutants (ie, those that have no threshold below which health effects do not occur) the **benefits** of development options which reduce population exposure should be evaluated.

¹⁰ <https://www.gov.uk/government/publications/cancer-risk-characterisation-methods>

Additional points specific to emissions to air

When considering baseline conditions (of existing air quality) and the assessment and future monitoring of impacts, these should include:

- consideration of impacts on existing areas of poor air quality eg, existing or proposed local authority Air Quality Management Areas (AQMAs) or Clean Air Zones (CAZ). The applicant should demonstrate close working/consultation with the appropriate local authorities.
- modelling using appropriate meteorological data (ie, from the nearest suitable meteorological station and include a range of years and worst-case conditions)
- modelling taking into account local topography, congestion and acceleration

Additional points specific to emissions to water

When considering baseline conditions (of existing water quality) and the assessment and future monitoring of impacts, these should:

- include assessment of potential impacts on human health and not focus solely on ecological impacts
- identify and consider all routes by which emissions may lead to population exposure (eg, surface watercourses, recreational waters, sewers, geological routes etc.)
- assess the potential off-site effects of emissions to groundwater (eg, on aquifers used for drinking water) and surface water (used for drinking water abstraction) in terms of the potential for population exposure
- include consideration of potential impacts on recreational users (eg, from fishing, canoeing etc.) alongside assessment of potential exposure via drinking water

Land quality

We would expect the applicant to provide details of any hazardous contamination present on site (including ground gas) as part of a site condition report and associated risk assessment.

Emissions to and from the ground should be considered in terms of the previous history of the site and the potential of the site, during construction and once operational, to give rise to issues. Public health impacts associated with ground contamination and/or the migration of material off-site should be assessed in accordance with the Environment Agency publication Land contamination: risk management¹¹ and the potential impact on nearby receptors; control and mitigation measures should be outlined.

Waste

¹¹ Available at <https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks>

The applicant should demonstrate compliance with the waste hierarchy (eg, with respect to re-use, recycling or recovery and disposal).

For wastes arising from the development the ES should assess:

- the implications and wider environmental and public health impacts of different waste disposal options
- disposal route(s) and transport method(s) and how potential impacts on public health will be mitigated

If the development includes wastes delivered to the installation:

- Consider issues associated with waste delivery and acceptance procedures (including delivery of prohibited wastes) and should assess potential off-site impacts and describe their mitigation

Accidents, Control of Major Accident Hazards (COMAH) sites and Perceived Risk

Within the ES, PHE would expect to see information about how the applicant would respond to accidents with potential off-site emissions (eg, flooding or fires, spills, leaks or releases off-site). Assessment of accidents should: identify all potential hazards in relation to construction, operation and decommissioning; include an assessment of the risks posed; and identify risk management measures and contingency actions that will be employed in the event of an accident in order to mitigate off-site effects.

PHE would expect the applicant to consider the COMAH Regulations and the Major Accident Off-Site Emergency Plan (Management of Waste from Extractive Industries) (England and Wales) Regulations: both in terms of their applicability to the development itself, and the development's potential to impact on, or be impacted by, any nearby installations themselves subject to these Regulations.

There is evidence that, in some cases, perception of risk may have a greater impact on health than the hazard itself. A 2009 report¹², jointly published by Liverpool John Moores University and the Health Protection Agency (HPA), examined health risk perception and environmental problems using a number of case studies. As a point to consider, the report suggested: "Estimation of community anxiety and stress should be included as part of every risk or impact assessment of proposed plans that involve a potential environmental hazard. This is true even when the physical health risks may be negligible." PHE supports the inclusion of this information within ES' as good practice.

Electric and Magnetic Fields

¹² *Health Risk Perception and Environmental Problems. Findings from ten case studies in the North West of England.* Available from: http://allcatsrgrey.org.uk/wp/download/public_health/Health-Risk-Perception-Env-Probs.pdf

This advice relates to electrical installations such as substations and connecting underground cables or overhead lines. PHE advice on the health effects of power frequency electric and magnetic fields is available on the Gov.UK website.¹³

There is a potential health impact associated with the electric and magnetic fields around substations, overhead power lines and underground cables. The field strengths tend to reduce with distance from such equipment.

The following information provides a framework for considering the health impact associated with the electric and magnetic fields produced by the proposed development, including the direct and indirect effects of the electric and magnetic fields as indicated above.

- **Policy Measures for the Electricity Industry**
A voluntary code of practice is published which sets out key principles for complying with the ICNIRP guidelines.¹⁴ Companion codes of practice dealing with optimum phasing of high voltage power lines and aspects of the guidelines that relate to indirect effects are also available.^{15,16}
- **Exposure Guidelines**
PHE recommends the adoption in the UK of the EMF exposure guidelines published by the International Commission on Non-ionizing Radiation Protection (ICNIRP). Formal advice to this effect, based on an accompanying comprehensive review of the scientific evidence, was published in 2004 by the National Radiological Protection Board (NRPB), one of PHE's predecessor organisations.¹⁷ Updates to the ICNIRP guidelines for static fields have been issued in 2009 and for low frequency fields in 2010. However, Government policy is that the ICNIRP guidelines are implemented as expressed in the 1999 EU Council Recommendation on limiting exposure of the general public (1999/519/EC).¹⁸
- **Static magnetic fields**
For static magnetic fields, the ICNIRP guidelines published in 2009 recommend that acute exposure of the general public should not exceed 400 mT (millitesla), for any part of the body, although the previously recommended value of 40 mT is

¹³ <https://www.gov.uk/government/collections/electromagnetic-fields#low-frequency-electric-and-magnetic-fields>

¹⁴ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/37447/1256-code-practice-emf-public-exp-guidelines.pdf

¹⁵ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48309/1255-code-practice-optimum-phasing-power-lines.pdf

¹⁶ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/224766/powerlines_vcop_microshocks.pdf

¹⁷ <http://webarchive.nationalarchives.gov.uk/20140629102627/http://www.hpa.org.uk/Publications/Radiation/NPRBArchive/DocumentsOfTheNRPB/Absd1502/>

¹⁸ http://webarchive.nationalarchives.gov.uk/+www.dh.gov.uk/en/PublicHealth/Healthprotection/DH_4089500

the value used in the Council Recommendation. However, because of potential indirect adverse effects, ICNIRP recognises that practical policies need to be implemented to prevent inadvertent harmful exposure of people with implanted electronic medical devices and implants containing ferromagnetic materials, and injuries due to flying ferromagnetic objects, and these considerations can lead to much lower restrictions, such as 0.5 mT.

- **Power frequency electric and magnetic fields**

At 50 Hz, the known direct effects include those of induced currents in the body on the central nervous system (CNS) and indirect effects include the risk of painful spark discharge on contact with metal objects exposed to electric fields. The ICNIRP guidelines published in 1998 give reference levels for public exposure to 50 Hz electric and magnetic fields, and these are respectively 5 kV m⁻¹ (kilovolts per metre) and 100 µT (microtesla). The reference level for magnetic fields changes to 200 µT in the revised (ICNIRP 2010) guidelines because of new basic restrictions based on induced electric fields inside the body, rather than induced current density. If people are not exposed to field strengths above these levels, direct effects on the CNS should be avoided and indirect effects such as the risk of painful spark discharge will be small. The reference levels are not in themselves limits but provide guidance for assessing compliance with underlying basic restrictions and reducing the risk of indirect effects.

- **Long term effects**

There is concern about the possible effects of long-term exposure to extremely low frequency electric and magnetic fields from power lines. In the NRPB advice issued in 2004, it was concluded that the studies that suggest health effects, including ones concerning childhood leukaemia in relation to power frequency magnetic fields, could not be used to derive quantitative guidance on restricting exposure. However, the results of these studies represented uncertainty in the underlying evidence base, and taken together with people's concerns, provided a basis for providing an additional recommendation for Government to consider the need for further precautionary measures, particularly with respect to the exposure of children to power frequency magnetic fields.

- **The Stakeholder Advisory Group on ELF EMFs (SAGE)**

SAGE was set up to explore the implications for a precautionary approach to extremely low frequency electric and magnetic fields (ELF EMFs), which include power frequency fields, and to make practical recommendations to Government.¹⁹ Relevant here is SAGE's 2007 First Interim Assessment, which made several recommendations concerning high voltage power lines. In responding,

¹⁹ <http://www.emfs.info/policy/sage/>

Government supported the implementation of low cost options such as optimal phasing to reduce exposure; however it did not support the option of creating corridors around power lines in which development would be restricted on health grounds, which was considered to be a disproportionate measure given the evidence base on the potential long term health risks arising from exposure. The Government response to SAGE's First Interim Assessment is available on the national archive website.²⁰

The Government also supported calls for providing more information on power frequency electric and magnetic fields²¹.

Ionising radiation

Particular considerations apply when an application involves the possibility of exposure to ionising radiation. In such cases it is important that the basic principles of radiation protection recommended by the International Commission on Radiological Protection²² (ICRP) are followed. PHE provides advice on the application of these recommendations in the UK. The ICRP recommendations are implemented in the Euratom Basic Safety Standards²³ (BSS) and these form the basis for UK legislation, including the Ionising Radiation Regulations 1999, the Radioactive Substances Act 1993, and the Environmental Permitting Regulations 2016.

As part of the EIA process PHE expects applicants to carry out the necessary radiological impact assessments to demonstrate compliance with UK legislation and the principles of radiation protection. This should be set out clearly in a separate section or report and should not require any further analysis by PHE. In particular, the important principles of justification, optimisation and radiation dose limitation should be addressed. In addition, compliance with the Euratom BSS and UK legislation should be clear.

When considering the radiological impact of routine discharges of radionuclides to the environment PHE would, as part of the EIA process, expect to see a full radiation dose assessment considering both individual and collective (population) doses for the public and, where necessary, workers. For individual doses, consideration should be given to those members of the public who are likely to receive the highest exposures (referred to as the representative person, which is equivalent to the previous term, critical group).

²⁰

http://webarchive.nationalarchives.gov.uk/20130107105354/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_107124

²¹ <https://www.gov.uk/government/collections/electromagnetic-fields#low-frequency-electric-and-magnetic-fields>

²² These recommendations are given in publications of the ICRP notably publications 90 and 103 see the website at <http://www.icrp.org/>

²³ Council Directive 96/29/EURATOM laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation.

Different age groups should be considered as appropriate and should normally include adults, 1 year old and 10 year old children. In particular situations doses to the fetus should also be calculated²⁴.

The estimated doses to the representative person should be compared to the appropriate radiation dose criteria (dose constraints and dose limits), taking account of other releases of radionuclides from nearby locations as appropriate. Collective doses should also be considered for the UK, European and world populations where appropriate.

The methods for assessing individual and collective radiation doses should follow the guidance given in 'Principles for the Assessment of Prospective Public Doses arising from Authorised Discharges of Radioactive Waste to the Environment August 2012'²⁵

It is important that the methods used in any radiological dose assessment are clear and that key parameter values and assumptions are given (for example, the location of the representative persons, habit data and models used in the assessment).

Any radiological impact assessment, undertaken as part of the EIA, should also consider the possibility of short-term planned releases and the potential for accidental releases of radionuclides to the environment. This can be done by referring to compliance with the Ionising Radiation Regulations and other relevant legislation and guidance.

The radiological impact of any solid waste storage and disposal should also be addressed in the assessment to ensure that this complies with UK practice and legislation; information should be provided on the category of waste involved (e.g. very low level waste, VLLW). It is also important that the radiological impact associated with the decommissioning of the site is addressed.

Of relevance here is PHE advice on radiological criteria and assessments for land-based solid waste disposal facilities²⁶. PHE advises that assessments of radiological impact during the operational phase should be performed in the same way as for any site authorised to discharge radioactive waste. PHE also advises that assessments of radiological impact during the post operational phase of the facility should consider long timescales (possibly in excess of 10,000 years) that are appropriate to the long-lived nature of the radionuclides in the waste, some of which may have half-lives of millions of years.

The radiological assessment should consider exposure of members of hypothetical representative groups for a number of scenarios including the expected migration of

²⁴ HPA (2008) Guidance on the application of dose coefficients for the embryo, fetus and breastfed infant in dose assessments for members of the public. Doc HPA, RCE-5, 1-78, available at

<https://www.gov.uk/government/publications/embryo-fetus-and-breastfed-infant-application-of-dose-coefficients>

²⁵ The Environment Agency (EA), Scottish Environment Protection Agency (SEPA), Northern Ireland Environment Agency, Health Protection Agency and the Food Standards Agency (FSA).

Principles for the Assessment of Prospective Public Doses arising from Authorised Discharges of Radioactive Waste to the Environment August 2012.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296390/geho1202bklh-e-e.pdf

²⁶ HPA RCE-8, Radiological Protection Objectives for the Land-based Disposal of Solid Radioactive Wastes, February 2009

radionuclides from the facility, and inadvertent intrusion into the facility once institutional control has ceased.

For scenarios where the probability of occurrence can be estimated, both doses and health risks should be presented, where the health risk is the product of the probability that the scenario occurs, the dose if the scenario occurs and the health risk corresponding to unit dose.

For inadvertent intrusion, the dose if the intrusion occurs should be presented. It is recommended that the post-closure phase be considered as a series of timescales, with the approach changing from more quantitative to more qualitative as times further in the future are considered.

The level of detail and sophistication in the modelling should also reflect the level of hazard presented by the waste. The uncertainty due to the long timescales means that the concept of collective dose has very limited use, although estimates of collective dose from the 'expected' migration scenario can be used to compare the relatively early impacts from some disposal options if required.

Noise from National Networks and Airports

Public Health England's mission is to protect and improve the nation's health and wellbeing and reduce health inequalities. Environmental noise can cause stress and disturb sleep, which over the long term can lead to a number of adverse health outcomes.^{27 28}

The Noise Policy Statement for England (NPSE)²⁹ sets out the government's overall policy on noise. Its aims are to:

- avoid significant adverse impacts on health and quality of life;
- mitigate and minimise adverse impacts on health and quality of life; and
- contribute to the improvement of health and quality of life.

These aims should be applied within a broader context of sustainable development, where noise is considered alongside other economic, social and environmental factors. PHE expects such factors may include³⁰:

- Ensuring healthy lives and promoting well-being for all at all ages;
- promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all;
- building resilient infrastructure, promoting inclusive and sustainable industrialisation and fostering innovation;

²⁷ World Health Organisation, *Environmental Noise Guidelines for the European Region*. 2018.

²⁸ Lercher, P., G. Aasvang, and Y.e. de Kluizenaar, *WHO Noise and Health Evidence Reviews*.

²⁹ DEFRA, *Noise Policy Statement for England*. 2010.

³⁰ United Nations. *Sustainable Development Goals*. 2020 [01/06/2020]; Available from: <https://sustainabledevelopment.un.org/?menu=1300>.

- reducing inequality; and
- making cities and human settlements inclusive, safe, resilient and sustainable.

PHE's consideration of the effects of health and quality and life attributable to noise is guided by the recommendations in the 2018 Environmental Noise Guidelines for the European Region²⁷ published by the World Health Organization, and informed by high quality systematic reviews of the scientific evidence^{28 31 32} The scientific evidence on noise and health is rapidly developing, and PHE's recommendations are also informed by relevant studies that are judged to be scientifically robust and consistent with the overall body of evidence.

In line with its mission, PHE believes that Nationally Significant Infrastructure Projects (NSIP) should not only limit significant adverse effects, but also explore opportunities to improve the health and quality of life of local communities and reduce inequalities.

PHE also recognises the developing body of evidence showing that areas of tranquillity offer opportunities for health benefits through psychological restoration. NSIP applications need to demonstrate that they have given due consideration to the protection of the existing sound environment in these areas.

Further, more detailed, guidance on PHE's scoping advice for noise issues associated with road schemes is included in Appendix 2

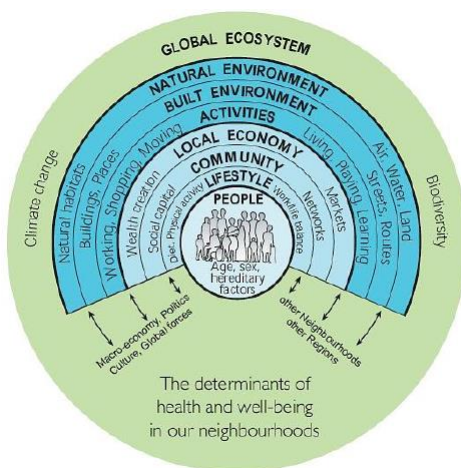
³¹ Clark, C., C. Crumpler, and A.H. Notley, *Evidence for Environmental Noise Effects on Health for the United Kingdom Policy Context: A Systematic Review of the Effects of Environmental Noise on Mental Health, Wellbeing, Quality of Life, Cancer, Dementia, Birth, Reproductive Outcomes, and Cognition*. Int J Environ Res Public Health, 2020. **17**(2).

³² van Kamp, I., et al., *Evidence Relating to Environmental Noise Exposure and Annoyance, Sleep Disturbance, Cardio-Vascular and Metabolic Health Outcomes in the Context of IGCB (N): A Scoping Review of New Evidence*. Int J Environ Res Public Health, 2020. **17**(9).

Health and Wellbeing - Wider Determinants of Health

The World Health Organization (WHO's) defines health as “a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity” (WHO, 1948).

The health and wellbeing of an individual or a population is the result of a complex interaction of a wide range of different determinants of health, from an individual's genetic make-up, to lifestyles and behaviours, and the communities, local economy, built and natural environments to global ecosystem trends. All developments will have some effect on the determinants of health, which in turn will influence the health and wellbeing of the general population, vulnerable groups and individual people.



Barton and Grant³³

PHE recognises that evaluating an NSIP's impacts on health through the wider determinants is more complex than assessing a project's direct impacts against clearly defined regulatory protections. The 2017 EIA Regulations clarify that the likely significant effects of a development proposal on population and human health must be assessed.

PHE's expectations are that the proponent of an NSIP will conduct a proportionate and evidence-based assessment of the anticipated direct and indirect effects on health and wellbeing in line with the relevant regulatory and policy requirements. Consideration should be given to impacts during the construction, operation and decommissioning phase of NSIPs. Consideration should be given to the avoidance or mitigation of any negative impacts, as well as to how the NSIP could be designed to maximise potential positive benefits.

³³ Barton H, Grant M. A health map for the local human habitat. The Journal of the Royal Society for the Promotion of Health 2006; 126(6): 252-3.

Scoping

We accept that the relevance of wider determinants and associated impacts will vary depending on the nature of the proposed development. PHE has focused its approach on scoping determinants of health and wellbeing under four themes, which have been derived from an analysis of the wider determinants of health mentioned in the National Policy Statements.

The four themes are:

- Access
- Traffic and Transport
- Socioeconomic
- Land Use

PHE has developed a list of 21 determinants of health and wellbeing under these four broad themes. These determinants should be considered within any scoping report and if the applicant proposes to scope any areas out of the assessment, they should provide clear evidence based reasoning and justification. Appendix 1 provides greater detail on the nature of each determinant.

Table 1- Health and wellbeing themes and wider determinants

Health and wellbeing themes			
Access	Traffic and Transport	Socioeconomic	Land Use
Wider determinants of health and wellbeing			
<p>Access to :</p> <ul style="list-style-type: none"> • local public and key services and facilities. • Good quality affordable housing. • Healthy affordable food. • The natural environment. • The natural environment within the urban environment. • Leisure, recreation and physical activities within the urban and natural environments. 	<ul style="list-style-type: none"> • Accessibility. • Access to/by public transport. • Opportunities for access by cycling and walking. • Links between communities. • Community severance. • Connections to jobs. • Connections to services, facilities and leisure opportunities. 	<ul style="list-style-type: none"> • Employment opportunities, including training opportunities. • Local business activity. • Regeneration. • Tourism and leisure industries. • Community/social cohesions and access to social networks. • Community engagement. 	<ul style="list-style-type: none"> • Land use in urban and/or /rural settings. • Quality of Urban and natural environments

Methodology

PHE will expect assessments to set out the methodology used to assess impacts on each determinant included in the scope of the assessment. In some instances, the methodologies described may be established and refer to existing standards and/or guidance. In other instances, there may be no pre-defined methodology, which can often be the case for the wider determinants of health; as such there should be an application of a logical evidence based impact assessment method that:

- identifies the temporal and geographic scope of assessment.
- identifies affected sensitive receptors (general population and vulnerable populations) to impacts from the relevant determinant
- establishes the current baseline situation.
- identifies the NSIP's potential direct and indirect impacts on each population.
- if impacts are identified, evaluates whether the potential effect is likely to be significant in relation to the affected population.
- identifies appropriate mitigation to eliminate or minimise impacts or the subsequent effects on health and inequalities.
- identifies opportunities to achieve benefits from the scheme for health and inequalities.
- considers any in combination or cumulative effects.
- identifies appropriate monitoring programmes.

Currently there is no standard methodology for assessing the population and human health effects of infrastructure projects, but a number of guides exist, including:

- Institute of Environmental Management and Assessment, 2017: Health in Environmental Assessment, a primer for a proportionate approach;
- NHS London Healthy Urban Development Unit (HUDU), 2015. Healthy Urban Planning Checklist and Rapid Health Impact Assessment Tool;
- Wales Health Impact Assessment Unit, 2012: HIA a practical guide; and

PHE expects assessments to follow best practice from these guides and from methodologies adopted within other successful health/environmental impacts assessments.

Determining significant effects

Neither the EIA regulations nor the National Policy Statements provide a definition of what constitutes a 'significant' effect, and so PHE have derived a list of factors which it will take into consideration in the assessment of significance of effects, as outlined below. These list of factors should be read in conjunction with guidance from the above guides.

- **Sensitivity:**
Is the population exposed to the NSIP at particular risk from effects on this determinant due to pre-existing vulnerabilities or inequalities (for example, are there high numbers in the local population of people who are young, older, with disabilities or long-term conditions, or on a low income)? Will the NSIP widen existing inequalities or introduce new inequalities in relation to this determinant?
- **Magnitude:**
How likely is the impact on this determinant to occur? If likely, will the impact affect a large number of people / Will the impact affect a large geographic extent? Will the effects be frequent or continuous? Will the effects be temporary or permanent and irreversible?
- **Cumulative effects:**
Will the NSIP's impacts on this determinant combine with effects from other existing or proposed NSIPs or large-scale developments in the area, resulting in an overall cumulative effect different to that of the project alone?

What are the cumulative effects of the impacts of the scheme on communities or populations. Individual impacts individually may not be significant but in combination may produce an overall significant effect.

- **Importance:**
Is there evidence for the NSIP's effect on this determinant on health? Is the impact on this determinant important in the context of national, regional or local policy?
- **Acceptability:**
What is the local community's level of acceptance of the NSIP in relation to this determinant? Do the local community have confidence that the applicants will promote positive health impacts and mitigate against negative health effects?
- **Opportunity for mitigation:**
If this determinant is included in the scope for the EIA is there an opportunity to enhance any positive health impacts and/or mitigate any negative health impacts?

Vulnerable groups

Certain parts of the population may experience disproportionate negative health effects as a result of a development. Vulnerable populations can be identified through research literature, local population health data or from the identification of pre-existing health conditions that increase vulnerability.

The effects on health and wellbeing and health inequalities of the scheme will have particular effect on vulnerable or disadvantaged populations, including those that fall within the list of protected characteristics. Some protected groups are more likely to have elevated vulnerability associated with social and economic disadvantages. Consideration should be given to language or lifestyles that influence how certain populations are affected by impacts of the proposal, for example non-English speakers may face barriers to accessing information about the works or expressing their concerns.

Equality Impact Assessments (EqIA) are used to identify disproportionate effects on Protected Groups (defined by the Equality Act, 2010), including health effects. The assessments and findings of the Environmental Statement and the EqIA should be cross referenced between the two documents, particularly to ensure the assessment of potential impacts for health and inequalities and that resulting mitigation measures are mutually supportive.

The Wales Health Impact Assessment Support Unit (WHIASU), provides a suggested guide to vulnerable groups:

Age related groups

- Children and young people
- Older people

Income related groups

- People on low income
- Economically inactive
- Unemployed/workless
- People who are unable to work due to ill health

Groups who suffer discrimination or other social disadvantage

- People with physical or learning disabilities/difficulties
- Refugee groups
- People seeking asylum
- Travellers
- Single parent families
- Lesbian, gay or transgender people
- Black and minority ethnic groups
- Religious groups

Geographical groups

- People living in areas known to exhibit poor economic and/or health indicators
- People living in isolated/over-populated areas

- People unable to access services and facilities

Mental health

PHE supports the use of the broad definition of health proposed by the World Health Organisation (WHO). Mental well-being is fundamental to achieving a healthy, resilient and thriving population. It underpins healthy lifestyles, physical health, educational attainment, employment and productivity, relationships, community safety and cohesion and quality of life. NSIP schemes can be of such scale and nature that they will impact on the over-arching protective factors, which are:

- Enhancing control
- Increasing resilience and community assets
- Facilitating participation and promoting inclusion.

There should be parity between mental and physical health, and any assessment of health impact should include the appreciation of both. A systematic approach to the assessment of the impacts on mental health, including suicide, is required. The Mental Well-being Impact Assessment (MWIA) could be used as a methodology. The assessment should identify vulnerable populations and provide clear mitigation strategies that are adequately linked to any local services or assets

Perceptions about the proposed scheme may increase the risk of anxiety or health effects by perceived effects. “Estimation of community anxiety and stress should be included as part of every risk or impact assessment of proposed plans that involve a potential environmental hazard.

Evidence base and baseline data

Evidence base and baseline data

Baseline population / community health data (quantitative and qualitative) Should be sufficient to represent current health status and identify areas or groups with poor health or inequalities. This should provide sufficient information on the physical and mental health and wellbeing and social determinants of health for the affected populations and any vulnerable groups identified.

A baseline health assessment could include:

- General population data (including size, density, age, gender, income and employment, socio-economic status, crime and disorder etc, health status.)
- Environmental information (housing, transport, access to services, provision and access to green space, tranquillity or sound environment)
- Data on behaviour, such as levels of physical activity, smoking, car usage, walking and cycling
- Surveys of local conditions
- Local concerns and anxieties (where documented)
- Secondary analysis of existing local data
- Resident surveys or consultations

- Health status, particularly of the population groups already identified as vulnerable and likely to benefit or be harmed by the proposal. This should include mental health and suicide.
- Quality of life indicators (if available / relevant)
- Local people's views of the area and of the services provided (community engagement exercises)

There will be a range of publicly available health data including:

- National datasets such as those from the Office of National Statistics,
- PHE, including the fingertips data sets,
- Non-governmental organisations,
- Local public health reports, such as the Joint Strategic Needs Assessment and Health and Wellbeing Strategies;
- Consultation with local authorities, including public health teams
- Information received through public consultations, including community engagement exercises

There should be a narrative which interprets the data collected in the context of the project. A list of tables and data is not sufficient, so the report should consider:

- Are particular groups or vulnerable groups likely to be impacted more than others and is this clearly described and explained?
- What indicators within the current health baseline that are worse than England average/ local ward or LSOA levels?
- What are the levels of inequality in the study area?
- What are the potential inequalities in the distribution of impacts?

Mitigation

If the assessment has identified that significant negative effects are likely to occur with respect to the wider determinants of health, the assessment should include a description of planned mitigation measures the applicant will implement to avoid or prevent effects on the population.

Mitigation and/or monitoring proposals should be logical, feasible and have a clear governance and accountability framework indicating who will be responsible for implementation and how this will be secured during the construction and/or operation of the NSIP.

Any proposed mitigation should have sufficient detail to allow for an assessment of the adequacy of the proposed mitigation measures.

Positive benefits from the scheme

The scale of many NSIP developments will generate the potential for positive impacts on health and wellbeing; however, delivering such positive health outcomes often requires specific enabling or enhancement measures. For example, the construction of a new road network to access an NSIP site may provide an opportunity to improve the active transport infrastructure for the local community. PHE expects developments to consider and report on the opportunity and feasibility of positive impacts. These may be stand alone or be considered as part of the

mitigation measures.

Replacement publicly accessible space or community assets

The replacement of community assets provides opportunity for positive impacts and the design, location and operation of the replacement asset should be considered in consultation with user, the local community and agencies.

Any replacement recreational land, open space or other community assets should be located and designed to:

- Not unreasonably extend journey times or increase transport costs, or result in too many people being prevented from travelling sustainably due to unsuitable walking or cycling routes.
- Ensure that accessibility planning has been properly taken into account and that the proposal will not adversely impact on disadvantaged groups.
- Meet identified community needs which may go beyond direct replacement but can be reasonably incorporated
- Provide acceptable recreational amenity, including noise environment, for outdoor spaces associated with the individual community facilities
- The design of the sites should be carried out in consultation with the local community. It should incorporate features and designs to enable access and use across the life course.
- The PEIR should contain sufficient detail regarding the location and design in order to determine the acceptability of the replacement facilities.
- Quality, quantity and accessibility should be determined against defined criteria agreed with stakeholders. The following evidence based assessment tools should be considered:

The quality of the provision of replacement green space should be assessed, for example by the use of:

Building with Nature - There are 6 wellbeing standards, which are:

- Accessible
- Inclusive
- Seasonal enjoyment
- Locally relevant
- Socially sustainable
- Distinctive

The **ANGSt standards** address amount, access and quality

The **ORVaL tool** - This tool works on areas that are currently publicly accessible and looks at welfare values for this area. The site functionality allows users to investigate how altering the land cover, features or the area of existing recreation sites will change usage and welfare values. This allows a comparison between existing and the proposed sites. Contact should be

made with the ORVaL team to establish the functionality of the tool relevant to the DCO and interpretation of the findings³⁴.

Green Flag Award- a robust framework for assessing the quality of public green spaces of all types and sizes.

Employment

NSIP schemes have the potential to negatively impact through the relocation or loss of local businesses. Equally they can offer an opportunity for new business activity and employment both at the construction stage and operation of the development approved by the DCO. There is clear evidence that good work improves health and wellbeing across people's lives and protects against social exclusion. Conversely, unemployment is bad for health and wellbeing, as it is associated with an increased risk of mortality and morbidity. For many individuals, in particular those with long-term conditions such as mental health problems, musculoskeletal (MSK) conditions and disabilities, health issues can be a barrier to gaining and retaining employment. Employment rates are lowest among disabled people, with only 51.3% in work, meaning there is a substantial employment rate gap in the UK between disabled and non-disabled people (81.4% in employment). Among these working age disabled people in the UK, 54% have a mental health or MSK condition as their main health condition³⁵. Enabling people with health issues to obtain or retain work, and be productive within the workplace, is a crucial part of the economic success and wellbeing of every community and industry. It is important that people are supported to gain employment and maintain economic independence for themselves and their families, especially as they age. This is of particular importance for individuals with long-term conditions and disabilities, due to the barriers they face in gaining employment and retaining a job.

Where relevant any assessments should include:

- The impact of business relocation in order to identify the likely level of job losses within the study area
- The proposed support mechanisms to be established for business owners and employees
- A clear strategy and action plan that addresses barriers to employment within the local population and those that cease employment due to the DCO.

Compulsory purchase

NSIP schemes can involve the compulsory acquisition of property from land take. Mitigation will involve supporting home owners and tenants in understanding and utilising the compensation and support offered through the compensation policies.

³⁴ https://www.leep.exeter.ac.uk/orval/pdf-reports/ORVal2_User_Guide.pdf

³⁵ PHE (Jan 2019). Guidance - Health matters: health and work (<https://publichealthmatters.blog.gov.uk/2019/01/31/health-matters-health-and-work/>)

The impacts from compulsory acquisition of land and property can affect health and wellbeing, including mental health, for example from home, school and employment relocation and loss of employment. This will be particularly relevant to sensitive receptors within communities, many of which will form part of the private rented sector.

Compensation and support can be an important element of mitigation, but developers should consider opportunities to work through partners and local Voluntary, Community and Social Enterprise (VCSE) organisations. These organisations offer the potential for engagement with vulnerable groups and may gain greater acceptance by the wider community.

Any compulsory purchase support schemes should ensure sufficient competency in public health, including public mental health, in order to help support local communities. The aim would be to establish a workforce that is confident, competent and committed to:

- promote good physical and mental health across the population
- prevent mental illness and suicide
- improve the quality and length of life of people living within affected communities

The Public mental health leadership and workforce development framework³⁶ published by PHE offers a skills framework for the wider public health workforce. As well as the competences in this framework. Health Education England (HEE) have published a course content guide entitled Public Mental Health Content Guide For introductory courses or professional development in mental health and wellbeing³⁷.

Monitoring

PHE expects an assessment to include consideration of the need for monitoring and the ES should clearly state the principles on which the monitoring strategy has been established, including monitoring in response to unforeseen impacts or effects.

It may be appropriate to undertake monitoring where:

- Critical assumptions have been made in the absence of supporting evidence or data
- There is uncertainty about whether significant negative effects are likely to occur and it would be appropriate to include planned monitoring measures to track their presence, scale and nature.
- There is uncertainty about the potential success of mitigation measures
- It is necessary to track the nature of the impact or effect and provide useful and timely feedback that would allow action to be taken should negative effects occur

The monitoring strategy should set out:

- Monitoring methodologies
- Data sources, particularly if being obtained from third parties or open access data

³⁶ Public mental health leadership and workforce development framework - Confidence, competence, commitment. PHE (2015)

³⁷ Public Mental Health Content Guide for introductory courses or professional development in mental health and wellbeing. Health education England

- Assessment methods
- Publication methodology
- Reporting frequency
- Temporal and geographic scope

For very large controversial schemes it may be worth considering the need to have an independent organisation undertake / report on the monitoring and the need for academic robustness.

Community based reports

Large complex schemes that involve significant effects on communities or significant cumulative effects can benefit from identifying impacts and reporting at an individual community level. This assists in the identification of the overall potential effects across a range of impacts. These community level reports will also aid local communities to engage with consultations by providing relevant and accessible information.

How to contact PHE

If you wish to contact us regarding an existing or potential NSIP application please email: nsipconsultations@phe.gov.uk

Appendix 1

Table 1 – Wider determinants of health and wellbeing

Health and wellbeing themes			
Access	Traffic and Transport	Socioeconomic	Land Use
Wider determinants of health and wellbeing			
<p>Access to :</p> <ul style="list-style-type: none"> • local public and key services and facilities. • Good quality affordable housing. • Healthy affordable food. • The natural environment. • The natural environment within the urban environment. • Leisure, recreation and physical activities within the urban and natural environments. 	<ul style="list-style-type: none"> • Accessibility. • Access to/by public transport. • Opportunities for access by cycling and walking. • Links between communities. • Community severance. • Connections to jobs. • Connections to services, facilities and leisure opportunities. 	<ul style="list-style-type: none"> • Employment opportunities, including training opportunities. • Local business activity. • Regeneration. • Tourism and leisure industries. • Community/social cohesions and access to social networks. • Community engagement. 	<ul style="list-style-type: none"> • Land use in urban and/or /rural settings. • Quality of Urban and natural environments

Access

- Access to local, public and key services and facilities
 Access to local facilities can increase mobility and social participation. Body mass index is significantly associated with access to facilities, including factors such as the mix and density of facilities in the area. The distance to facilities has no or only a small effect on walking and other physical activities. Access to recreational facilities can increase physical activity, especially walking for recreation, reduce body weight, reduce the risk of high blood pressure, and reduce the number of vehicle trips, the distances travelled and greenhouse gas emissions.

Local services include health and social care, education, employment, and leisure and recreation. Local facilities include community centres, shops, banks/credit unions and Post Offices. Services and facilities can be operated by the public, private and/or voluntary sectors. Access to services and facilities is important to both physical and mental health and wellbeing. Access is affected by factors such as availability, proximity to people's place of residence, existence of transport services or active travel infrastructure to the location of services and facilities, and the quality of services and facilities.

The construction or operation of an NSIP can affect access adversely: it may increase demand and therefore reduce availability for the existing community; during construction, physical accessibility may be reduced due to increased traffic and/or the blockage of or changes to certain travel routes. It is also possible that some local services and facilities are lost due to the land-take needed for the NSIP.

Conversely if new routes are built or new services or facilities provided the NSIP may increase access. NSIPs relating to utilities such as energy and water can maintain, secure or increase access to those utilities, and thereby support health and wellbeing.

- Access to good-quality affordable housing
Housing refurbishment can lead to an improvement in general health and reduce health inequalities. Housing improvements may also benefit mental health. The provision of diverse forms and types of housing is associated with increased physical activity. The provision of affordable housing is strongly associated with improved safety perceptions in the neighbourhood, particularly among people from low-income groups. For vulnerable groups, the provision of affordable housing can lead to improvements in social, behavioural and health related outcomes. For some people with long term conditions, the provision of secure and affordable housing can increase engagement with healthcare services, which can lead to improved health-related outcomes. The provision of secure and affordable housing can also reduce engagement in risky health-related behaviours. For people who are homeless, the provision of affordable housing increases engagement with healthcare services, improves quality of life and increases employment, and contributes to improving mental health.

Access to housing meets a basic human need, although housing of itself is not necessarily sufficient to support health and wellbeing: it is also important that the housing is of good quality and affordable. Factors affecting the quality of housing include energy efficiency (eg effective heating, insulation), sanitation and hygiene (eg toilet and bathroom), indoor air quality including ventilation and the presence of damp and/or mould, resilience to climate change, and overcrowding. The

affordability of housing is important because for many people, especially people on a low income, housing will be the largest monthly expense; if the cost of housing is high, people may not be able to meet other needs such as the need for heating in winter or food. Some proposals for NSIPs include the provision of housing, which could be beneficial for the health and wellbeing of the local population. It is also possible that some housing will be subject to a compulsory purchase order due to the land-take needed for an NSIP.

- Access to affordable healthy food

Access to healthy food is related to the provision of public and active transport infrastructure and the location and proximity of outlets selling healthier food such as fruit and vegetables. For the general population, increased access to healthy, affordable food through a variety of outlets (shops, supermarkets, farmers' markets and community gardens) is associated with improved dietary behaviours, including attitudes towards healthy eating and food purchasing behaviour, and improved adult weight. Increased access to unhealthier food retail outlets is associated with increased weight in the general population and increased obesity and unhealthy eating behaviours among children living in low-income areas. Urban agriculture can improve attitudes towards healthier food and increase fruit and vegetable consumption.

Factors affecting access to healthy affordable food include whether it is readily available from local shops, supermarkets, markets or delivery schemes and/or there are opportunities to grow food in local allotments or community gardens. People in environments where there is a high proportion of fast food outlets may not have easy access to healthy affordable food.

- Access to the natural environment

Availability of and access to safe open green space is associated with increased physical activity across a variety of behaviours, social connectedness, childhood development, reduced risk of overweight and obesity and improved physical and mental health outcomes. While the quantity of green space in a neighbourhood helps to promote physical activity and is beneficial to physical health, eg lower rates of mortality from cardiovascular disease and respiratory disease in men, the availability of green environments is likely to contribute more to mental health than to physical health: the prevalence of some disease clusters, particularly anxiety and depression, is lower in living environments which have more green space within a 1-km radius.

The proximity, size, type, quality, distribution, density and context of green space are also important factors. Quality of green space may be a better predictor of health than quantity, and any type of green space in a neighbourhood does not necessarily act as a venue for, or will encourage, physical activity. 'Walkable'

green environments are important for better health, and streetscape greenery is as strongly related to self-reported health as green areas. Residents in deprived areas are more likely to perceive access to green space as difficult, to report poorer safety, to visit the green space less frequently and to have lower levels of physical activity. The benefits to health and wellbeing of blue space include lower psychological distress.

The natural environment includes the landscape, waterscape and seascape. Factors affecting access include the proximity of the natural environment to people's place of residence, the existence of public transport services or active travel infrastructure to the natural environment, the quality of the natural environment and feelings of safety in the natural environment. The construction of an NSIP may be an opportunity to provide green and/or blue infrastructure in the local area. It is also possible that green or blue infrastructure will be lost due to the land-take needed for the NSIP.

- Access to the natural environment within the urban environment
Public open spaces are key elements of the built environment. Ecosystem services through the provision of green infrastructure are as important as are other types of urban infrastructure. It supports physical, psychological and social health, although the quality, perceptions of safety and accessibility of green space affects its use, . Safe parks may be particularly important for promoting physical activity among urban adolescents. Proximity to urban green space and an increased proportion of green space are associated with decreased treatment of anxiety/mood disorders, the benefits deriving from both participation in usable green space near to home and observable green space in the neighbourhood. Urban agriculture may increase opportunities for physical activity and social connections.

A view of 'greenery' or of the sea moderates the annoyance response to noise. Water is associated with positive perceptive experiences in urban environments, with benefits for health such as enhanced contemplation, emotional bonding, participation and physical activity. Increasing biodiversity in urban environments, however, may promote the introduction of vector or host organisms for infectious pathogens, eg green connectivity may potentiate the role of rats and ticks in the spread of disease, and bodies of water may provide habitats for mosquitoes.

The natural environment within the urban environment includes the provision of green and blue space in towns and cities. Factors involved in access include the proximity of the green and/or blue space to people's place of residence, the existence of transport services or active travel infrastructure to the green and/or blue space, the quality of the green and/or blue space and feelings of safety when using the green and/or blue space. The construction of an NSIP may be an

opportunity to provide green and/or blue infrastructure in the local urban environment. It is also possible that green or blue infrastructure in the urban environment will be lost due to the land-take needed for the NSIP.

- Access to leisure, recreation and physical activity opportunities within the urban and natural environments.

Access to recreational opportunities, facilities and services is associated with risk factors for long-term disease; it can increase physical activity, especially walking for recreation, reduce body mass index and overweight and obesity, reduce the risk of high blood pressure, and reduce the number of vehicle trips, the distances travelled and greenhouse gas emissions. It can also enhance social connectedness. Children tend to play on light-traffic streets, whereas outdoor activities are less common on high-traffic streets. A perception of air pollution can be a barrier to participating in outdoor physical activity³⁸. However, the health co-benefits from physical activity outweigh the adverse effects of air pollution. There is a positive association between urban agriculture and increased opportunities for physical activity and social connectivity. Gardening in an allotment setting can result in many positive physical and mental health-related outcomes. Exercising in the natural environment can have a positive effect on mental wellbeing when compared with exercising indoors.

Leisure and recreation opportunities include opportunities that are both formal, such as belonging to a sports club, and informal, such as walking in the local park or wood. Physical activity opportunities include routine activity as part of daily life, such as walking or cycling to work, and activity as part of leisure or recreation, such as playing football. The construction of an NSIP may enhance the opportunities available for leisure and recreation and physical activity through the provision of new or improved travel routes, community infrastructure and/or green or blue space. Conversely, construction may reduce access through the disruption of travel routes to leisure, recreation and physical activity opportunities.

Traffic and Transport

- Accessibility
Walkability, regional accessibility, pavements and bike facilities are positively associated with physical activity and negatively related to body weight and high blood pressure, and reduce the number of vehicle trips, the distances travelled and greenhouse gas emissions. Body mass index is associated with street

³⁸ Annear, M., Keeling, S., Wilkinson, T., Cushman, G., Gidlow, B., & Hopkins, H. (2014). Environmental influences on healthy and active ageing: A systematic review. *Ageing & Society*, 34 (4), 590-622. Available at https://www.academia.edu/34314864/Environmental_influences_on_healthy_and_active_ageing_a_systematic_review

network accessibility and slope variability.

Accessibility in relation to transport and travel has several aspects including whether potential users can gain physical access to the infrastructure and access to the services the infrastructure provides. The design and operation of transport infrastructure and the associated services should take account of the travel needs of all potential users including people with limited mobility. People whose specific needs should be considered include pregnant women, older people, children and young people and people with a disability. Other aspects of transport infrastructure affecting accessibility include safety and affordability, both of which will affect people's ability to travel to places of employment and/or key local services and facilities and/or access their social networks.

- Access to / by public transport

Provision of high-quality public transport is associated with higher levels of active travel among children and among people commuting to work, with a decrease in the use of private cars. Combining public transport with other forms of active travel can improve cardiovascular fitness. Innovative or new public transport interventions may need to be marketed and promoted differently to different groups of transport users, eg by emphasising novelty to car users while ensuring that the new system is seen by existing users as coherently integrated with existing services.

Transport facilitates access to other services, facilities and amenities important to health and wellbeing. Public transport is any transport open to members of the public including bus, rail and taxi services operated by the public, private or community sectors. For people who do not have access to private transport, access to public transport is important as the main agency of travel especially for journeys >1 mile. Access to public transport is not sufficient, however, and access by public transport needs to be taken into account: public transport services should link places where people live with the destinations they need or want to visit such as places of employment, education and healthcare, shops, banks and leisure facilities. Other aspects of access to public transport include affordability, safety, frequency and reliability of services.

- Opportunities for / access by cycling & walking

Walking and cycling infrastructure can enhance street connectivity, helping to reduce perceptions of long-distance trips and providing alternative routes for active travel. Awareness of air pollution, could be a barrier to participating in active travel³¹, however those that choose to walk or cycle often experience lower

exposure to pollution, and create less pollution than those in vehicles³⁹.

Prioritising pedestrians and cyclists through changes in physical infrastructure can have positive behavioural and health outcomes, such as physical activity, mobility and cardiovascular outcomes. The provision and proximity of active transport infrastructure is also related to other long-term disease risk factors, such as access to healthy food, social connectedness and air quality.

Perceived or objective danger may also have an adverse effect on cycling and walking, both of which activities decrease with increasing traffic volume and speed, and cycling for leisure decreases as local traffic density increases. Health gains from active travel policies outweigh the adverse effects of road traffic incidents. New infrastructure to promote cycling, walking and the use of public transport can increase the time spent cycling on the commute to work, and the overall time spent commuting among the least-active people. Active travel to work or school can be associated with body mass index and weight, and may reduce cardiovascular risk factors and improve cardiovascular outcomes. The distance of services from cycle paths can have an adverse effect on cycling behaviour, whereas mixed land use, higher densities and reduced distances to non-residential destinations promote transportation walking.

- **Links between communities**
Social connectedness can be enhanced by the provision of public and active transport infrastructure and the location of employment, amenities, facilities and services.
- **Community severance**
In neighbourhoods with high volumes of traffic, the likelihood of people knowing and trusting neighbours is reduced.
- **Connections to jobs**
The location of employment opportunities and the provision of public and active transportation infrastructure are associated with risk factors for long-term disease such as physical activity. Good pedestrian and cycling infrastructure can promote commuting physical activity. Improved transport infrastructure has the potential to shift the population distribution of physical activity in relation to commuting, although a prerequisite may be a supportive social environment. Mixed land use, higher densities and reduced distances to non-residential destinations promote transportation walking.

The ease of access to employment, shops and services including the provision of public and active transport are important considerations and schemes should take

³⁹ Defra 2019, Clean Air Strategy 2019. Available at <https://www.gov.uk/government/publications/clean-air-strategy-2019>

any opportunity to improve infrastructure to promote cycling, walking and the use of public transport

- Connections to services, facilities and leisure opportunities
Mixed land use, higher densities and reduced distances to non-residential destinations promote transportation walking. Access to recreational opportunities and the location of shops and services are associated with risk factors for long-term disease such as physical activity, access to healthy food and social connectedness. Increased distance of services from cycle paths can have an adverse effect on cycling behaviour.

Socio Economic

- Employment opportunities including training opportunities
Employment is generally good for physical and mental health and well-being, and worklessness is associated with poorer physical and mental health and well-being. Work can be therapeutic and can reverse the adverse health effects of unemployment for healthy people of working age, many disabled people, most people with common health problems and social security beneficiaries. Account must be taken of the nature and quality of work and its social context and jobs should be safe and accommodating. Overall, the beneficial effects of work outweigh the risks of work and are greater than the harmful effects of long-term unemployment or prolonged sickness absence. Employment has a protective effect on depression and general mental health.

Transitions from unemployment to paid employment can reduce the risk of distress and improve mental health, whereas transitions into unemployment are psychologically distressing and detrimental to mental health. The mental health benefits of becoming employed are also dependent on the psychosocial quality of the job, including level of control, demands, complexity, job insecurity and level of pay: transition from unemployment to a high-quality job is good for mental health, whereas transition from unemployment to a low-quality job is worse for mental health than being unemployed. For people receiving social benefits, entry into paid employment can improve quality of life and self-rated health (physical, mental, social) within a short time-frame. For people receiving disability benefits, transition into employment can improve mental and physical health. For people with mental health needs, entry into employment reduces the use of mental health services.

For vocational rehabilitation of people with severe mental illness (SMI), Supported Employment is more effective than Pre-vocational Training in helping clients obtain competitive employment; moreover, clients in Supported Employment earn

more and work more hours per month than those in Pre-vocational Training.

- Local Business Activity

It is important to demonstrate how a proposed development will contribute to ensuring the vitality of town centres. Schemes should consider the impact on local employment, promote beneficial competition within and between town centres, and create attractive, diverse places where people want to live, visit and work

In rural areas the applicant should assess the impact of the proposals on a prosperous rural economy, demonstrate how they will support the sustainable growth and expansion of all types of business and enterprise in rural areas, promoting the development and diversification of agricultural and other land based rural businesses.

- Regeneration

Following rebuilding and housing improvements in deprived neighbourhoods, better housing conditions are associated with better health behaviours; allowing people to remain in their neighbourhood during demolition and rebuilding is more likely to stimulate life-changing improvements in health behaviour than in people who are relocated. The partial demolition of neighbourhoods does not appear to affect residents' physical or mental health. Mega-events, such as the Olympic Games, often promoted on the basis of their potential legacy for regeneration, appear to have only a short-term impact on mental health.

- Tourism and Leisure Industries

The applicant should assess the impact of the proposed development on retail, leisure, commercial, office, tourism, cultural, community and residential development needed in town centres. In rural locations assessment and evaluation of potential impacts on sustainable rural tourism and leisure developments that benefit businesses in rural areas, communities and visitors should be undertaken.

- Community / social cohesion and access to social networks

The location of employment, shops and services, provision of public and active transport infrastructure and access to open space and recreational opportunities are associated with social connectedness. Access to local amenities can increase social participation. Neighbourhoods that are more walkable can increase social capital. Urban agriculture can increase opportunities for social connectivity. Infrastructure developments, however, can affect the quality of life of communities living in the vicinity, mediated by substantial community change, including feelings of threat and anxiety, which can lead to psychosocial stress and intra-community conflict.

- Community engagement
Public participation can improve environmental impact assessments, thereby increasing the total welfare of different interest groups in the community. Infrastructure development may be more acceptable to communities if it involves substantial public participation.

Land Use

- Land use in urban and / or rural settings
Land-use mix including infrastructure:
Land use affects health not only by shaping the built environment, but also through the balance of various types of infrastructure including transport. Vulnerable groups in the population are disproportionately affected by decisions about land use, transport and the built environment. Land use and transport policies can result in negative health impacts due to low physical activity levels, sedentary behaviours, road traffic incidents, social isolation, air pollution, noise and heat. Mixed land use can increase both active travel and physical activity. Transportation walking is related to land-use mix, density and distance to non-residential destinations; recreational walking is related to density and mixed use. Using modelling, if land-use density and diversity are increased, there is a shift from motorised transport to cycling, walking and the use of public transport with consequent health gain from a reduction in long-term conditions including diabetes, cardiovascular disease and respiratory disease.
- Quality of urban and natural environments
Long-term conditions such as cardiovascular disease, diabetes, obesity, asthma and depression can be moderated by the built environment. People in neighbourhoods characterised by high 'walkability' walk more than people in neighbourhoods with low 'walkability' irrespective of the land-use mix. In neighbourhoods associated with high 'walkability' there is an increase in physical activity and social capital, a reduction in overweight and blood pressure, and fewer reports of depression and of alcohol abuse. The presence of walkable land uses, rather than their equal mixture, relates to a healthy weight. Transportation walking is at its highest levels in neighbourhoods where the land-use mix includes residential, retail, office, health, welfare and community, and entertainment, culture and recreation land uses; recreational walking is at its highest levels when the land-use mix includes public open space, sporting infrastructure and primary and rural land uses. Reduced levels of pollution and street connectivity increase participation in physical activity.

Good-quality street lighting and traffic calming can increase pedestrian activity, while traffic calming reduces the risk of pedestrian injury. 20-mph zones and limits

are effective at reducing the incidence of road traffic incidents and injuries, while good-quality street lighting may prevent them. Public open spaces within neighbourhoods encourage physical activity, although the physical activity is dependent on different aspects of open space, such as proximity, size and quality. Improving the quality of urban green spaces and parks can increase visitation and physical activity levels.

Living in a neighbourhood overlooking public areas can improve mental health, and residential greenness can reduce the risk of cardiovascular mortality. Crime and safety issues in a neighbourhood affect both health status and mental health. Despite the complexity of the relationship, the presence of green space has a positive effect on crime, and general environmental improvements may reduce the fear of crime. Trees can have a cooling effect on the environment – an urban park is cooler than a non-green site. Linking road infrastructure planning and green infrastructure planning can produce improved outcomes for both, including meeting local communities' landscape sustainability objectives.

Appendix 2

NSIP National Networks – Road schemes (scoping stage)

Public Health England Generic Response: Noise and Public Health

Guiding principles

Public Health England's mission is to protect and improve the nation's health and wellbeing and reduce health inequalities. Environmental noise can cause stress and disturb sleep, which over the long term can lead to a number of adverse health outcomes [1, 2]. The Noise Policy Statement for England (NPSE) [3] sets out the government's overall policy on noise. Its aims are to:

- avoid significant adverse impacts on health and quality of life;
- mitigate and minimise adverse impacts on health and quality of life; and
- contribute to the improvement of health and quality of life.

These aims should be applied within a broader context of sustainable development, where noise is considered alongside other economic, social and environmental factors. PHE expects such factors may include [4]:

- Ensuring healthy lives and promoting well-being for all at all ages;
- promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all;
- building resilient infrastructure, promoting inclusive and sustainable industrialisation and fostering innovation;
- reducing inequality; and
- making cities and human settlements inclusive, safe, resilient and sustainable.

PHE's consideration of the effects of health and quality and life attributable to noise is guided by the recommendations in the 2018 Environmental Noise Guidelines for the European Region [1] published by the World Health Organization, and informed by high quality systematic reviews of the scientific evidence [2, 5, 6]. The scientific evidence on noise and health is rapidly developing, and PHE's recommendations are also informed by relevant studies that are judged to be scientifically robust and consistent with the overall body of evidence.

In line with its mission, PHE believes that Nationally Significant Infrastructure Projects (NSIP) should not only limit significant adverse effects, but also explore opportunities to improve the health and quality of life of local communities and reduce inequalities.

PHE also recognises the developing body of evidence showing that areas of tranquillity offer opportunities for health benefits through psychological restoration. NSIP applications need to demonstrate that they have given due consideration to the protection of the existing sound environment in these areas.

Significance of Impacts

Determining significance of impacts is an essential element of an Environmental Impact Assessment, and therefore significance needs to be clearly defined at the earliest opportunity by the Applicant. PHE recommends that the definition of significance is discussed and agreed with relevant stakeholders, including local authority environmental health and public health teams and local community representatives, through a documented consultation process. PHE recommends that any disagreement amongst stakeholders on the methodology for defining significance is acknowledged in the planning application documentation and could inform additional sensitivity analyses.

For noise exposure, PHE expects assessments of significance to be closely linked to the associated impacts on health and quality of life, and not on noise exposure per se (in line with the NPSE). The latest revision of the Design Manual for Roads and Bridges (DMRB) Table 3.49 LA111 [7] includes proposed values for the Lowest Observable Adverse Effect Level (LOAEL) and Significant Observable Adverse Effect Level (SOAEL)⁴⁰ for operational noise, and these values are likely to inform judgements on significance of impact. Whilst DMRB does not explicitly reference the underpinning evidence that informed these numbers, the night time LOAEL and SOAEL of 40 dB L_{night} (outside, free-field) and 55 dB L_{night} (outside, free-field) respectively, correspond to the guideline value and interim target proposed in the WHO Night Noise Guidelines (2009) [8]. The Night Noise Guidelines emphasized that the interim target was “not a health-based limit value by itself. Vulnerable groups cannot be protected at this level”.

The daytime SOAEL of 68 dB LA_{10,18hr} (façade) appears to be derived from the relative noise level in the Noise Insulation Regulations (NIR) [9], which is linked to the provision of enhanced noise insulation for new highway infrastructure. The NIR does not explicitly refer to the underpinning evidence on which the relevant noise level is based, and there is a lack of good quality evidence linking noise exposure expressed in the LA₁₀ metric to health effects. Therefore, it is helpful to convert these levels to L_{den} and L_{Aeq,16hr} metrics, which are more widely used in the noise and health literature. Assuming motorway traffic, a level of 68 dB LA_{10,18hr} (façade) is approximately

⁴⁰ As defined in the Noise Policy Statement for England [3] and the Planning Practice Guidance [14].

equivalent to 41 free-field outdoor levels of 69dB Lden (or 42 64LAeq,16hr). The corresponding internal noise levels are approximately 54dB LAeq,16hr (open windows), 48dB LAeq,16hr (tilted windows) and 36dB LAeq,16hr (closed windows).

For construction noise the latest revision of the DMRB makes reference to Section E3.2 and Table E.1 in Annex E (informative) of BS 5228-1:2009+A1:2014 [10] for the definition of SOAELs. Table E.1 of BS 5228-1:2009+A1:2014 provides examples of threshold values in three categories, based on existing ambient values. Threshold values are higher when ambient noise levels are higher. Daytime (07:00-19:00, weekdays) thresholds can be traced back to principles promoted by the Wilson Committee in 1963 [11]: “Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut.” The Wilson committee also recommended that “Noisy work likely to cause annoyance locally should not be permitted between 22.00 hours and 07.00 hours.” BS 5228 states that these principles have been expanded over time to include a suite of noise levels covering the whole day/week period taking into account the varying sensitivities through these periods.

With reference to the noise exposure hierarchy table in the Planning Practice Guidance (Noise) [14], PHE is not aware of good quality scientific evidence that links specific noise levels to behavioural/attitudinal changes in the general population. Reactions to noise at an individual level are strongly confounded by personal, situational and environmental non-acoustic factors [16, 17], and large inter-personal variations are observed in the reaction of a population to a particular noise level [18-21]. For these reasons PHE is not able to provide evidence-based general recommendations for SOAELs that are able to achieve the aims and objectives of the Noise Policy Statement for England and the Planning Practice Guidance on noise. DMRB allows for project specific LOAELs and SOAELs to be defined if necessary, and PHE recommends that for each scheme the Applicant gives careful consideration of the following:

- The existing noise exposure of affected communities – in particular, consideration of any designated Noise Important Areas identified in proximity to the scheme;
- The size of the population affected – for example an effect may be deemed significant if a large number of people are exposed to a relatively small noise change;
- The relative change in number and type of vehicle pass-bys;

⁴¹ Using equation 4.16 from [22], assuming free-field levels; $L_{A10,18hr}(\text{free-field}) = L_{A10,18hr}(\text{façade}) - 2.5\text{dB(A)}$ as per CRTN [13].

⁴² Using conversion factors in para. 2.2.13 Transport Analysis Guidance (TAG) Unit A3 [15]

⁴³ Using external – internal level differences reported by Locher et al. (2018) [12], based on measurements at 102 dwellings in Switzerland in 2016.

- Changes in the temporal distribution of noise during day/evening/night, or between weekdays and weekends;
- Soundscape and tranquillity, in particular the value that communities put on the lack of environmental noise in their area, or conversely, on the lack of public areas within walking distance that are relatively free from environmental noise;
- Opportunities for respite (predictable periods of relief from noise), either spatially or temporally;
- Cumulative exposure to other environmental risk factors, including other sources of noise and air pollution,
- Local health needs, sensitivities and objectives.

The WHO Environmental Noise Guidelines (2018) do not define LOAELs for environmental noise sources, partly because the scientific evidence suggests that there is no clear threshold where adverse impacts on health and quality of life cease to occur in the general population. Based on the systematic reviews that informed the 2018 WHO Environmental Noise Guidelines [2], the daytime operational noise LOAEL quoted in DMRB is equivalent to approximately 8% of the population Highly Annoyed⁴⁴, and the night time LOAEL is equivalent to approximately 2% of the population Highly Sleep Disturbed⁴⁵. Therefore, the impact assessment should acknowledge that adverse health effects will occur beyond the assessment threshold (LOAEL). PHE recommends that the Applicant explains what its chosen SOAELs for a specific scheme mean in population health terms in a similar fashion.

PHE does not believe that the current scientific evidence supports the modification of SOAELs and UAELs based on the existing noise insulation specification of residential dwellings, and in particular whether enhanced sound insulation avoids significant adverse effects on health and quality of life. See also sections on Mitigation and Step Changes in Noise Exposure.

Health Outcomes

PHE encourages the applicant to present noise exposure data in terms of the Lden metric (in addition to Leq and L10), to facilitate interpretation by a broad range of stakeholders. This is because most recent scientific evidence on the health effects of environmental noise is presented in terms of Lden [1, 5, 6]. PHE believes that

⁴⁴ 55 dB LA_{10,18hr} (façade) is approximately equal to 57 dB L_{den} (free-field), assuming motorway traffic [13, 22]. Applying the exposure-response function presented in Guski et al., 2017 [19] for road traffic noise and annoyance (excluding Alpine and Asian studies), approximately 8% of a population is highly annoyed at 57 dB L_{den}.

⁴⁵ Applying the exposure-response function presented in Basner et al., 2018 [20] for road traffic noise and sleep disturbance gives the result that approximately 2% of a population is highly sleep disturbed at 40 dB L_{night}.

quantifying the health impacts associated with noise exposure and presenting them in health-based metrics allows decision makers to make more informed decisions.

For transportation sources, PHE recommends the quantification of health outcomes using the methodology agreed by the Interdepartmental Group on Costs and Benefits - Noise subgroup [IGCB(N) [23] (currently under review)), and more recent systematic reviews [1, 5, 6]. PHE believes there is sufficient evidence to quantify the following health outcomes: long-term annoyance, sleep disturbance, ischaemic heart disease (IHD), and potentially stroke⁴⁶ and diabetes⁴⁷. Effects can be expressed in terms of number of people affected, number of disease cases, and Disability Adjusted Life Years (DALYs). THE IGCB(N) guidance can also be used to translate these effects into monetary terms.

Some health outcomes, namely annoyance and self-reported sleep disturbance, can be influenced by the local context and situation. In these cases, it would be preferable to use exposure-response functions (ERFs) derived in a local context. However, PHE is not aware of any ERFs for road traffic being available for a UK context from data gathered in the last two decades. Therefore, in PHE's view the ERFs presented in the WHO-commissioned systematic reviews offer a good foundation for appraisal of the health effects associated with road traffic noise [2]. For annoyance, the average curve derived excluding Alpine and Asian studies may be considered more transferable to a UK context. For metabolic outcomes, no ERF was published in the WHO ENG 2018. A recent meta-analysis of five cohort studies of road traffic noise and incidence of diabetes was reported by Vienneau in 2019 [24].

Where schemes have the potential to impact a large number of people, PHE expects the Applicant to carry out literature scoping reviews to ensure that the most robust and up-to-date scientific evidence is being used to quantify adverse effects attributable to the Scheme.

PHE expects to see a clear outline of the steps taken to arrive at the final judgement of significance based on these health outcomes, including a description of local circumstances and modifiers anticipated, and how reasonably foreseeable changes in these circumstances will be dealt with during the assessment process.

⁴⁶ A literature review commissioned by Defra [6] identified nine longitudinal studies on road traffic noise and incidence of stroke, and eight longitudinal studies on road traffic noise and stroke mortality.

⁴⁷ A literature review commissioned by Defra [6] identified four longitudinal studies on road traffic noise and incidence of diabetes.

Identification and Consideration of Receptors

The identification of noise sensitive receptors in proximity to the proposed scheme - or route options - is essential in providing a full assessment of potential impacts. Examples of noise sensitive receptors include but are not limited to:

- Noise Important Areas
- Residential areas
- Schools, hospitals and care homes
- Community green and blue spaces and areas valued for their tranquillity, such as local and national parks
- Public Rights of Way (PRoWs)

Noise Important Areas (NIAs) are areas with the highest levels of noise exposure at a national level and as such require very careful consideration in terms of protection from increased noise levels as well as opportunities for noise mitigation that can lead to an improvement in health and quality of life. DMRB requires a list of noise mitigation measures that the project will deliver in Noise Important Areas. PHE supports this requirement - new development should offer an opportunity to reduce the health burden of existing transport infrastructure, particularly for those worst affected. PHE would encourage this approach to extend beyond NIAs, in line with the third aim of NPSE [3].

Baseline Sound Environment

The greater the understanding of the baseline sound environment, the greater the potential for the assessment to reflect the nature and scale of potential impacts, adverse or beneficial, associated with the Scheme. PHE recommends that traditional averaged noise levels are supplemented by a qualitative characterisation of the sound environment, including any particularly valued characteristics (for example, tranquillity) and the types of sources contributing to it [25].

PHE recommends that baseline noise surveys are carried out to provide a reliable depiction of local diurnal noise variations for both weekdays and weekends, in a variety of locations, including the difference between day (07:00-19:00), evening (19:00-23:00) and night-time (23:00-07:00) periods. This is particularly important if there are areas within the scheme assessment boundary with atypical traffic day/evening/night distributions. Achieving these aims is likely to require long-term noise monitoring in multiple locations for a period greater than seven days. This information should be used to test the robustness of any conversions between noise metrics (e.g. converting from LA10,18hr to LAeq,2300-0700 and Lden).

PHE suggests that a variety of metrics can be used to describe the sound environment with and without the scheme – for example, levels averaged over finer time periods, background noise levels expressed as percentiles, and number of event metrics (e.g. N65 day, N60 night) – and that, where possible, this suite of metrics is used to inform judgements of significance. There is emerging evidence that intermittency metrics can have an additional predictive value over traditional long-term time-averaged metrics for road traffic noise [27].

Mitigation

PHE expects decisions regarding noise mitigation measures to be underpinned by good quality evidence, in particular whether mitigation measures are proven to reduce adverse impacts on health and quality of life. For interventions where evidence is weak or lacking, PHE expects a proposed strategy for monitoring and evaluating their effectiveness during construction and operation, to ensure the effectiveness of said measures.

With regards to road traffic noise, low-noise road surfaces, acoustic barriers, traffic management and noise insulation schemes can all be considered. Priority should be given to reducing noise at source, and noise insulation schemes should be considered as a last resort. PHE expects any proposed noise insulation schemes to take a holistic approach which achieves a healthy indoor environment, taking into consideration noise, ventilation, overheating risk, indoor air quality and occupants' preference to open windows. There is, at present, insufficient good quality evidence as to whether insulation schemes are effective at reducing long-term annoyance and self-reported sleep disturbance [28], and initiatives to evaluate the effectiveness of noise insulation to improve health outcomes are strongly encouraged.

PHE notes the suggestion in DMRB methodology that post-construction noise monitoring cannot provide a reliable gauge for reference against predicted impacts of operational noise. The issues highlighted in DMRB relate to noise exposure, and not to health outcomes. PHE suggests that monitoring of health and quality of life can be considered pre and post operational phases, to ascertain whether mitigation measures are having the desired effect for local communities.

PHE expects consideration of potential adverse effects due to noise and vibration during construction and recommends that a full and detailed Construction Environmental Management Plan (CEMP) is developed and implemented by the Applicant and/or the contractor responsible for construction. PHE recommends that the CEMP includes a detailed programme of construction which highlights the times and durations of particularly noisy works, the measures taken to reduce noise at source, the strategy for actively communicating this information to local communities, and procedures for responding effectively to any specific issues arising.

There is a paucity of scientific evidence on the health effects attributable to construction noise associated with large infrastructure projects [5, 6] where construction activities

may last for a relatively long period of time. PHE recommends that the Applicant considers emerging evidence as it becomes available and reviews its assessment of impacts as appropriate.

Green Spaces and Private Amenity Areas

PHE expects proposals to take into consideration the evidence which suggests that quiet areas can have both a direct beneficial health effect and can also help restore or compensate for the adverse health effects of noise in the residential environment [29-31]. Research from the Netherlands suggests that people living in noisy areas appear to have a greater need for areas offering quiet than individuals who are not exposed to noise at home [29]. Control of noise at source is the most effective mitigation for protecting outdoor spaces; noise insulation schemes do not protect external amenity spaces (such as private gardens and balconies or community recreation facilities and green spaces) from increased noise exposure.

PHE expects consideration to be given to the importance of existing green spaces as well as opportunities to create new tranquil spaces which are easily accessible to those communities exposed to increased noise from the scheme. These spaces should be of a high design quality and have a sustainable long-term management strategy in place.

Step-changes in Noise Exposure and the Change-effect

The Applicant should take into consideration the “change-Effect”, i.e. the potential for a real or anticipated step-change in noise exposure to result in attitudinal responses that are greater or lower than that which would be expected in a steady state scenario [28, 32]. Where a perception of change is considered likely, PHE recommends that the change-effect is taken into account in the assessment for the opening year of the proposed development. For longer term assessments, the effects of population mobility need to be taken into consideration.

Community Engagement and Consultation Feedback

PHE recommends that public consultations carried out during the planning application process clearly identify the predicted changes to the sound environment during construction and operation of the Scheme, the predicted health effects on neighbouring communities, proposed noise mitigation strategies and any proposed measures for monitoring that such mitigation measures will achieve their desired outcomes.

PHE encourages the Applicant to use effective ways of communicating any changes in the acoustic environment generated by the scheme to local communities. For example, immersive and suitably calibrated audio-visual demonstrations can help make noise and visual changes more intuitive to understand and accessible to a wider demographic. If

the proposed scheme will have an impact over a relatively large geographical area, the Applicant should consider community-specific fact-sheets and/or impact maps, which are easily accessible to all individuals both in hard copy and online. If online, search functionality can potentially be included, for example, by postcode.

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