Cambridge Waste Water Treatment Plant Relocation Project
Anglian Water Services Limited

Appendix 12.2: Health Evidence Review

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Contents

Summary

This document provides a commentary on the links between the health determinants (environmental, social and economic factors that influence health) and health requirements, and provides commentary on the resulting effects on health and wellbeing, based on a review of available literature. Health inequalities exist across a range of dimensions or characteristics, including but not exclusive to the Equality Act protected characteristics, socio-economic position, life course stages and geography. Addressing impacts on this outcome (that is each of the affected population characteristics) is useful to understand the effect on population and spatial inequalities to target where actions can be beneficial and help monitor effects on people's general health and wellbeing over time.

The topics that have been scoped in for this evidence review are:

- Environment
  - Air quality
  - Odour
  - Traffic
  - Noise
  - Visual
  - Polluted water
- Hazardous waste
- Pests
- Access to green space, recreation and physical activity
- Access to services
  - Health care
  - Education
- Employment and income
- Social capital

1 Commentary on evidence for health determinants

1.1 Introduction

1.1.1 This document provides a commentary on the links between the health determinants (environmental, social and economic factors that influence health) that are assessed in the Health Methods presented in Environmental Statement (ES) and the National Planning Statement (NPS) health requirements, and provides commentary on the resulting effects on health and wellbeing, based on a review of available literature.

1.2 Health inequalities

1.2.1 Health inequalities exist across a range of dimensions or characteristics, including but not exclusive to the Equality Act protected characteristics, socio-economic position, life course stages and geography. These can be affected by different experiences of wider determinants of health, such as a combination of amenity, access and socio-economic effects. Addressing impacts on this outcome (that is each of the affected population characteristics) is useful to understand the effect on population and spatial inequalities to target where actions can be beneficial and help monitor effects on people's general health and wellbeing over time.

1.2.2 The existing health and deprivation status of the local population, as identified in Table 3-2 and Table 3-3 of Chapter 12: Health (Application Document reference 5.2.12), show that 23% of the study area fall within the two most deprived quintiles, which is higher than the Cambridgeshire region but lower than the national average. The community of Fen Ditton has almost half of its population (46%) falling in the most deprived quintile, which makes this population more susceptible to any changes in access, amenity and socio-economic in determining their health and wellbeing.

1.2.3 People living in deprived areas have less access to nature, and green and open spaces, as well as physical access and awareness of local health and social care services (Marsh, 2021). Opportunities for active travel are similarly more likely to be limited. Environmental disturbances arising through construction activities, including noise, air, odour and visual pollution plus traffic and transport, are thought to contribute to social inequalities in health, as disadvantaged groups are more exposed to such pollution and subsequently more sensitive to the resulting health effects (Deguen, 2010). For further equalities analysis, refer to the Equality Impact Assessment (App Doc Refence 7.12).

1.2.4 The mental health of individuals is influenced by social and environmental factors, such as having the ability to earn enough money, feeling part of a community, access to local services, employment and neighbourhood quality. Considerations for those with mental disabilities, such as dementia and autism also require changes in the way places and spaces are designed. While mental health data is not available at the level of the study area, Table 3-6 of the Human Health Chapter shows that life satisfaction for South Cambridgeshire, where the majority of the Proposed Development is located, is lower than in East Cambridgeshire and Cambridge City,

but higher than the England ratings. Addressing the impact on this outcome through, for example the 'Mental Wellbeing Impact Assessment' (App Doc Reference12.3), can ensure design and management of the Proposed Development give parity to mental and physical health needs.

1.2.5 Protection of the public's health through the environment on issues such as road accidents, air, noise and light pollution, land and water heavy metal and chemical poisoning from areas such as contaminated brownfield sites, extreme hot and cold weather, and community safety, are determinants that require consideration. Addressing impacts on this outcome can help identify, assess and control factors in the environment that protects the public's health from radiation, chemicals, and other natural and human-made hazards.

1.3 Environment

1.3.1 The following paragraphs outline how various considerations can have an impact on people's health and wellbeing, as found in the existing literature.

Air quality

1.3.2 Poor air quality causes a wide range of negative effects on people in the immediate surroundings. Outdoor air pollution is recognised by the WHO (World Health Organization, 2018a) as a major environmental health problem for all countries. The health effects of air pollution are complex, and range in severity of impact. In some cases, damage can be gradual and may not become apparent for many years.

1.3.3 Public Health England Guidance states that poor air quality is the largest environmental risk to public health in the UK, noting that 'studies have shown that long-term exposure to air pollution (over years or lifetimes) reduces life expectancy, mainly due to cardiovascular and respiratory diseases and lung cancer. Short-term exposure (over hours or days) to elevated levels of air pollution can also cause a range of health impacts, including effects on lung function, exacerbation of asthma, increases in respiratory and cardiovascular hospital admissions and mortality. The guidance also highlights that air pollutants can impact the eyes, nose, throat and heart as well as the lungs as respiratory system.

1.3.4 There are three main conditions associated with air pollution, which are respiratory conditions (such as asthma), cardiovascular disease (CVD), and lung cancer, and there is emerging evidence for associations with low birth weight and type 2 diabetes (Public Health England, 2018). One third of deaths from stroke, lung cancer and heart disease are due to air pollution, with nine out of ten people throughout the globe now breathing polluted air, which kills 7 million people every year globally (World Health Organization, 2022). There is also emerging evidence of associations between poor air quality, and poor mental health and mental disorders including bipolar and depression and Alzheimer's (Khan, 2019), with studies hypothesising that pollutants affect the human brain via neuroinflammatory pathways.

1.3.5 Therefore, the evidence linking air quality to health and wellbeing is considered to be strong.

Hazardous waste

1.3.6 According to the Health and Safety Executive (Health and safety Executive, 2020) ‘waste is considered 'hazardous' under [UK] environmental legislation when it contains substances or has properties that might make it harmful to human health or the environment. This does not necessarily mean it is an immediate risk to human health, although some waste can be.’

1.3.7 There is increasing evidence to suggest direct health effects of residential hazardous waste exposure. In some cases, hazardous substances may irritate the skin or eyes, make it difficult to breathe, cause headaches and nausea, or result in other types of illness. Some hazardous substances can cause far more severe health effects, including behavioral abnormalities, cancer, genetic mutations, physiological malfunctions, physical deformations, and birth defects (EPA, 2022).

1.3.8 A selection of reviewed epidemiological investigations on the health status of populations living near hazardous waste sites has provided evidence of causal relationships with hazardous waste for: liver, bladder, breast and testis cancers, non-Hodgkin lymphoma, asthma, congenital anomalies overall and anomalies of the neural tube, urogenital, connective and musculoskeletal systems, low birth weight and pre-term birth (Fazzo, et al., 2017).

1.3.9 Based on the literature reviewed, the evidence linking hazardous waste to health and wellbeing is considered to be strong.

Noise

1.3.10 Guidance published by the WHO (World Health Organization, 2017b) states that ‘excessive noise seriously harms human health and interferes with people’s daily activities at school, at work, at home and during leisure time. It can disturb sleep, cause cardiovascular and psychophysiological effects, reduce performance and provoke annoyance responses and changes in social behaviour.'

1.3.11 Noise pollution affects human health most commonly through Noise Induced Hearing Loss (NIHL), and in other cases exposure to loud noise can also cause high blood pressure, heart disease, sleep disturbances, and stress. General effects include fatigue, interference with communication and sleep, reduced efficiency and damaged hearing, while biological effects include constriction of blood vessels, tightening of muscles, increased heart rate and blood pressure and changes in stomach and abdomen movement. Regular exposure to noise, or exposure to very loud noise, can cause temporary or permanent hearing damage (Environmental Protection UK, n,d.).

1.3.12 There is also emerging evidence suggesting a negative association between noise exposure and mental health outcomes such as emotional distress and sleep disturbance in adults and children, particularly in low-income groups (Lim, 2018). Moreover, a 2014 study found traffic noise exposure to be one of the greatest environmental risk factors impacting public health, citing negative health impacts including sleep disturbance and ischemic heart disease (Hänninen, 2014).

1.3.13 Noise-associated health problems impact all age groups, but particularly children. Many children who live near noisy airports or streets have been found to suffer from stress and other problems, such as impairments in memory, attention and concentration levels, and reading skill (National Geographic, 2022). Furthermore, a review of inequalities in environmental noise exposure produced by the WHO indicates that noise exposure-related health impacts were greater in groups with lower economic status (World Health Organization, 2018b).

1.3.14 Based on the literature reviewed, the evidence linking noise to health and wellbeing is considered to be strong.

Odour

1.3.15 Exposure to odours could result in health effects ranging from none, to mild discomfort, to more serious symptoms. Strong odours may cause coughing, nausea and breathing issues in the short-term, while exposure to odour in the long-term can affect mood, anxiety and stress level. However, the evidence linking odours to health effects is much more sparse and less conclusive than the linkage with air pollutants (Eykelbosh, 2021).

1.3.16 However, odours can impact health through multiple mechanisms. Symptoms can be induced by exposure to odorants at levels that cause irritation, while health symptoms from non-irritant odours can be due to innate or learned aversions. Otherwise, symptoms may be due to a co-pollutant that is part of an odorant mixture. Odours emitted from large animal production facilities and waste water treatment plants, for example, elicit complaints of eye, nose, and throat irritation, headache, nausea, diarrhea, hoarseness, sore throat, cough, chest tightness, nasal congestion, palpitations, shortness of breath, stress, drowsiness, and alterations in mood (Schiffman, 2005).

1.3.17 Based on the literature reviewed here and applicable to this Project, the evidence linking odour to health and wellbeing is considered to be moderate.

Pests

1.3.18 Serious and fatal diseases can be disseminated or triggered by pests. For example, pests such as mosquitoes, ticks and rodents can spread vector-borne diseases (human illnesses caused by parasites, viruses and bacteria that are transmitted by vectors). The WHO defines vectors as ‘living organisms that can transmit infectious pathogens between humans, or from animals to humans. Many of these are bloodsucking insects…’ (World Health Organization, 2020). Examples include mosquitoes which spread viruses causing Zika virus and yellow fever and ticks who can spread bacteria caused by Lyme disease.

1.3.19 Research has also found that allergens associated with pests, particularly those found in urban environments, such as cockroaches, dust mites and rodents can trigger asthma symptoms and allergic reactions (World Health Organization, 2008).

1.3.20 Bacteria and viruses can result in diseases and infections such as coronaviruses, avian flu, prions and anthrax (EPA, 2022). Whilst such illnesses can have a negative

effect on mental health, there is limited evidence to suggest a link between pest infestations and mental health, with studies tending to draw connections between poor housing quality, infestation, and mental health (Bashir, 2002).

1.3.21 Based on the literature reviewed, the evidence linking pests to health and wellbeing is considered to be strong.

Polluted water

1.3.22 Water pollution can be defined as 'contamination of water sources by substances which make the water unusable for drinking, cooking, cleaning, swimming, and other activities. Pollutants include chemicals, trash, bacteria, and parasites' (Harvard School of Public Health, 2020).

1.3.23 Contaminated water and poor sanitation are linked to transmission of diseases such as cholera, diarrhea, dysentery, hepatitis A, typhoid and polio. Inadequate or poorly managed water and sanitation services expose individuals to preventable health risks.

1.3.24 The World Health Organization also reports that 80% diseases are waterborne, with industrialisation, discharge of waste and leakage from water tanks being major sources of water pollution, with significant human health effects (Haseena, 2017). Specifically, regarding the effects of consuming water contaminated with sewage, robust monitoring of waste water treatment systems must be put in place to avoid the risks of polluted water. Inadequate management of industrial waste water means the drinking-water of the surrounding population can also be dangerously contaminated or chemically polluted (World Health Organization, 2021).

1.3.25 Literature also raises concerns around microplastic pollution in water bodies and water supply and its effect on human health. Key sources of microplastics in water bodies include runoff from land-based sources, waste water effluent, combined sewer overflows, industrial effluent, atmospheric deposition and drinking water production. Emerging research suggests microplastic intake by humans can cause negative health outcomes due to their toxicological effect and potential damage to organ function (World Health Organization, 2019).

1.3.26 Based on the literature reviewed, the evidence linking polluted water to health and wellbeing is considered to be strong.

Traffic

1.3.27 Literature cites several ways in which traffic can impact health outcomes, including pollution, collisions, and reduction in social capital.

1.3.28 Traffic-related air pollution (TRAP) is associated with a wide range of adverse human health effects, particularly in urban areas. This comprises vehicle exhausts, secondary pollutants formed in the atmosphere, evaporative emissions from vehicles, and non-combustion emissions (e.g. road dust, tire wear). Exposure to this mixture of gasses and particles can exacerbate cardiovascular health issues, including asthma, reduced lung function, myocardial infarction, progression of

atherosclerosis, and cardiovascular mortality (Matz, 2019). Moreover, increased traffic heightens the chance of road traffic collisions, which can cause deaths and injuries, and impact mental health of those involved (Transport for London, 2021).

1.3.29 Furthermore, road traffic may inhibit access to goods, services and people, in turn resulting in community severance. This may cause reductions in physical activity (which has strong associations with negative health outcomes (as outlined under Access to green space, recreation and physical activity) and a reduction in social contact and access to services (Mindell, 2012), which can result in a reduction in social capital and lead to associated negative health outcomes (refer to Social capital).

1.3.30 Based on the literature reviewed, the evidence linking traffic to health and wellbeing is considered to be strong.

Visual amenity

1.3.31 The Green Infrastructure 2013 Position Statement (Landscape Institute, 2013) studying links between the quality of places and health and wellbeing cited evidence to suggest that health and wellbeing are influenced positively by the perceived attractiveness of the environment.

1.3.32 Similarly, a study by Seresinhe et al. (Seresinhe, 2015) stated that 'inhabitants of more scenic environments report better health, across urban, suburban and rural areas, even when taking core socioeconomic indicators of deprivation into account, such as income, employment and access to services.'

1.3.33 Visual pollution can come in many forms and is mostly caused by human action. Effects of exposure to visual pollution on physical and mental wellbeing include distraction, eye fatigue, increased risk of accidents, and loss of identity. The pollutant arises from confusion in the brain's processing of inconsistent visual inputs, which negatively impact individual health in general, particularly psychological wellbeing (Said, 2021).

1.3.34 Based on the literature reviewed, the evidence linking the visual environment to health and wellbeing is considered to be strong.

1.4 Access to green space, recreation and physical activity

1.4.1 A review by Public Health England concluded that 'living in a greener environment can promote and protect good health, and aid in recovery from illness and help with managing poor health. People who have greater exposure to greenspace have a range of more favourable physiological outcomes. Greener environments are also associated with better mental health and wellbeing outcomes including reduced levels of depression, anxiety, and fatigue, and enhanced quality of life for both children and adults. Greenspace can help to bind communities together, reduce loneliness, and mitigate the negative effects of air pollution, excessive noise, heat and flooding. Disadvantaged groups appear to gain a larger health benefit and have reduced socioeconomic-related inequalities in health when living in greener communities' (Public Health England, 2022).

1.4.2 Similarly, the World Health Organization conducted an evidence review which showed that urban parks and vegetation have beneficial effects on health, such as improved mental health, reduced cardiovascular morbidity, obesity and risk of type 2 diabetes (World Health Organization, 2016). Such spaces also support and facilitate social interaction, providing indirect benefits for mental health by creating opportunities for recreation and increased sense of community belonging. Such outdoor recreational opportunities also promote physical activity, which can in turn prevent noncommunicable diseases such as heart disease, stroke and diabetes and associated risk factors such as obesity. 'Active' transport choices such as walking and cycling are also facilitated through well designed and easily accessed greenspaces, which in turn reduces transport-related air pollutants, improves local air quality and therefore resulting in positive outcomes for respiratory health (World Health Organization, 2021).

1.4.3 Based on the literature reviewed, the strength of evidence is moderate for a direct causal relationship between access to green space, recreation and physical activity and health outcomes.

1.5 Access to services (health care and education)

Health care

1.5.1 Evidence indicates that access to healthcare services has a significant impact on health and wellbeing. Literature highlights that both the use of and access to these services is dependent on proximity, transport facilities and the supply of trained staff.

1.5.2 Transport has been cited as a key barrier to healthcare access (Syed, 2013). Unreliable transport options can result in rescheduled or missed appointments, resulting in delayed or lack of care and therefore poorer health outcomes. Health services can help to prevent disease and disability, identify and treat illness, increase life expectancy and reduce the likelihood of premature death, all of which in turn increases quality of life (Office of Disease Prevention and Health Promotion, 2020). Therefore, inability to travel to healthcare providers reduces the ability to identify and treat illness, resulting in poorer health outcomes.

1.5.3 An insufficient supply of trained staff may restrict the availability of medical care and services, resulting in delays in the identification and treatment and illness, and the quality of care, resulting in poor patient satisfaction. A recent study also indicates that staffing levels in medical facilities has a significant impact on patient satisfaction (Winter, 2020). Low patient satisfaction may act as a deterrent for accessing medical assistance in the future, therefore resulting in poorer health outcomes.

Education

1.5.4 Education has been identified as a key determinant affecting the health of individuals and communities, with 'higher income and social status are linked to better health. The greater the gap between the richest and poorest people, the greater the differences in health' (World Health Organization, 2017a).

1.5.5 The PHE Health Profile for England (Public Health England, 2018c) states that 'Educational attainment is strongly linked with health behaviours and outcomes. Better-educated individuals are less likely to suffer from long term diseases, to report themselves in poor health, or to suffer from mental conditions such as depression or anxiety. Education provides knowledge and capabilities that contribute to mental, physical, and social wellbeing. Educational qualifications are also a determinant of an individual's labour market position, which in turn influences income, housing and other material resources associated with health.'

1.5.6 The NBER similarly identifies causal links between behaviors associated with health factors such as smoking, drinking, diet and exercise and length of experience in formal education. For example, those who are in longer periods of education have been identified as less likely to smoke, be heavy drinkers or be overweight or obese (National Bureau of Economic Research, 2007).

1.5.7 Literature also indicates that attaining higher levels of education significantly reduces the likelihood of chronic disease (except for those with substantial genetic causes) (Smith, 2015), and that in higher-income countries lower educational attainment is linked to increased obesity (Cohen, 2013). The Proposed Development should therefore aim to avoid adverse effects to educational outcomes and consequential impacts on health.

1.5.8 Overall, based on the literature reviewed, the strength of evidence is strong for a causal relationship between public service access and health outcomes.

1.6 Employment and income

1.6.1 The WHO (World Health Organization, 2017a) highlights income and social status as a key determinant affecting the health of individuals and communities, stating that 'higher income and social status are linked to better health. The greater the gap between the richest and poorest people, the greater the differences in health.' Similarly, the Marmot Review indicated that 'being in good employment is protective of health. Conversely, unemployment contributes to poor health' (Marmot M. A., 2010). An updated review published in 2020 linked a fall in life expectancy in the most deprived communities outside London to 'the conditions in which people are born, grow, live, work and age and inequities in power, money and resources – the social determinants of health.' and also stated that 'The poorest areas have the highest preventable mortality rates and the richest areas have the lowest' (Marmot M. A., 2020).

1.6.2 The PHE Health Profile for England (Public Health England, 2018c) stated that 'Many physical and mental health outcomes improve incrementally as income rises. Income is related to life expectancy, disability free life expectancy, self-reported health and a range of biomarkers. The relationship operates through a variety of mechanisms. Financial resources determine the extent to which a person can both invest in goods and services which improve health and purchase goods and services which are bad for health. Low incomes can also prevent active participation in social life and day to day activities, affecting feelings of self-worth and status.' Commenting on the impacts of work on health, the report states that 'On the whole, work is good for

mental and physical health. In addition to the health benefits associated with an adequate wage, work can provide valuable social interactions, a place to develop and practice skills, and a sense of social participation and contribution to society.'

1.6.3 Based on the literature reviewed, the evidence linking income and employment to health and wellbeing is considered to be strong.

1.7 Social capital

1.7.1 The Office for National Statistics (ONS) provides the following definition of social capital 'In general terms, social capital represents social connections and all the benefits they generate' (Office for National Statistics, 2015). The benefits for people having these social connections can occur either at an individual level (for example, through family support) or at a wider collective level (for example, through volunteering). Social capital is also associated with values such as tolerance, solidarity or trust. These are beneficial to society and are important for people to be able to cooperate.' This study found that social capital can make a positive contribution to a range of well-being and health benefits at individual, community, regional and national levels.

1.7.2 Whilst there is limited evidence to support a clinical association between social capital and health outcomes, social capital is considered to be an important determinant of life expectancy and cardiovascular health (Choi, 2014). Evidence also suggests that cognitive social capital, such as shared norms, values and attributes, encourages mutually beneficial collective action and improves the prevention and control of chronic non-communicable disease (such as cardiovascular diseases, cancers and diabetes) (Hu, 2014).

1.7.3 ONS also cite evidence that those with a higher frequency and wider range of social contact have higher levels of life satisfaction, happiness and mental health and that those individuals who are more socially isolated are at greater risk of behaviors which can negatively affect health, such as drinking, smoking and low levels of physical activity (Office for National Statistics, 2015). Connections between social cohesion and health outcomes such as physical activity and depression have also been found (Pérez, 2020).

1.7.4 Research has found that there are several mechanisms by which social capital can have a positive impact on health (Rocco, 2012). Firstly, greater social interaction can result in better access to health-related information such as information on disease prevention and how to access health services. Secondly, greater social connections between households and family groups may enable greater cooperation and informal health care support by community support networks (i.e. taking care of each other or providing resources for each other in the event of illness). For example, research has shown that ethnic minorities concentrated within neighbourhoods often have better health outcomes than would be expected based on their, often low, socio-economic position (Uphoff, 2013). Finally, well organised and connected groups are more effective at lobbying authorities for changes to facilities which may improve public health, such as health infrastructure, recreational facilities, and green spaces, therefore indirectly improving public health.

1.7.5 The Proposed Development's environmental measures should therefore aim to reduce, or reverse, any loss of social capital in order to maintain or improve health outcomes. Based on the literature reviewed, the evidence linking social capital to health and wellbeing is considered to be moderate.

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You can view all our DCO application documents and updates on the application on The Planning Inspectorate website:

https://infrastructure.planninginspectorate.gov.uk/projects/eastern/cambridge-waste-water-treatment-plant-relocation/