

18 Health and Well-being

18.1 Introduction

18.1.1 In 2004 the Department for Environment, Food and Rural Affairs (Defra) commissioned a comprehensive review of the information available on the physical environmental and health effects of options, including incineration, for the management of municipal solid wastes and other similar wastes. The report was updated (Defra, 2011) to include an analysis of costs and benefits in monetary terms, but the conclusions with respect to physical effects remain almost unchanged. In his forward to the 2004 review report (Defra, 2004) the Minister of State, Environment & Agri-Environment noted:

“... the report’s conclusion that, on the evidence from studies so far, the treatment of municipal solid waste has at most a minor effect on health in this country particularly when compared with other risks associated with ordinary day to day living”

18.1.2 This theme was also picked up by Defra’s Chief Scientific Advisor in his forward to the same review report (Defra, 2004), in which he states that:

“The review has concluded that the effects on health from emissions from incineration, largely to air, are likely to be small in relation to other known risks to health. I have confidence in this conclusion, particularly bearing in mind the fact that the current generation of municipal solid waste incinerators have to comply with much more stringent emission standards than those which formed the basis for the majority of studies of health effects in the literature. This does not mean that we can afford to be complacent; rigorous enforcement will be crucial to ensure that the new emission standards are not exceeded, and that non-standard operating conditions, as noted by the Royal Society, do not lead to levels of emission which would give rise to concern”.

18.1.3 In 2010 the Health Protection Agency (HPA) published advice on the impacts on health of emissions to air from municipal waste incinerators (HPA, 2010) and confirmed that the evidence base for the Defra report had not changed significantly since 2004. With respect to planning applications to build EfW facilities or environmental permit applications to operate EfW facilities, *“the HPA’s view is that the study undertaken for Defra by Enviro can be relied on although, like all scientific findings, it may be subject to revision if new data were to emerge”.*

18.1.4 Findings of the reviews reported by Defra (Defra, 2004 & 2011) and the HPA (HPA, 2010) of particular relevance to this assessment are that:

- Evidence in the scientific literature relating to the effect of waste incinerators on populations living around them have been based on older plant, operated to emission limits that were higher during the study period than is currently permitted, and these studies reported a low risk to health.
- The conclusions of studies based at older incinerators in earlier decades can not be directly extrapolated, with any reliability, to calculate the effect of modern plant operating to more stringent emission limits. However, the relative magnitude of impacts from modern EfW facilities on ambient air pollutant concentrations are demonstrably lower.

- The contributions to air pollutant concentrations made by modern well managed EfW facilities are so small that, if effects on health exist, they are likely to be very small and not detectable.
 - Methods have been developed for the assessment of effects of air pollutants emitted by industrial processes on the health of local populations and so long as the data and associated uncertainties are considered appropriately, then these methods provide useful information. Too much weight should not be put on small differences between already small numbers.
 - Ambient concentrations of air pollutants, including the contribution of emissions from an EfW facility, can be compared against national air quality standards if a standard has been set (H.M Government, 2000, 2002.) If the standard is not exceeded, it can reasonably be assumed that the additional risk to health imposed by the emissions from the EfW facility would be minimal.
- 18.1.5 The impact of deprivation or life style factors such as smoking, diet or low levels of exercise on life expectancy and peoples functional capacity, are greater than the impact of exposure to ambient air pollutants, at the range of concentrations currently experienced in the UK's towns and cities. When considering health effects in areas surrounding single point sources of air pollution, such as EfW facilities, deprivation and life style factors will exert a strong influence on the health outcomes under consideration. It may not be possible to fully control for the uncertainty introduced by these factors within a project specific impact assessment, due to the relatively small populations, short timescales and small impacts involved (HPA, 2010). To control for uncertainty in the estimates of specific impacts, the adoption of a conservative approach is a common feature of the numerical methods used and as a consequence the reported impacts tend to represent over-estimates of impacts.
- 18.1.6 The current body of evidence as reported by the Health Protection Agency (HPA, 2010) and by Defra (Defra, 2004) demonstrates very clearly that the operation of a modern, well managed EfW facility within any urban centre in the UK is likely to cause a very small, if detectable, effect on the health of those living in the surrounding area. This chapter considers specific effects on health and well-being of the residents of Plymouth and surrounding areas, from the construction and operation of the proposed EfW facility at the application site.

Scope

- 18.1.7 This chapter identifies potential impacts of the operation of the proposed EfW CHP facility, on the health and well-being of local communities, that are directly associated with air quality, acoustics (noise and vibration) or with road vehicle movements. The significance of the effect on human health and well-being of these impacts is assessed.
- 18.1.8 At the present time it is not usual practice, in England, to include a specific chapter on health and well-being issues within an Environmental Statement for a proposed energy from waste facility. Consequently, there is no statutory guidance as to the most appropriate methods to apply for this purpose nor the assessment criteria to be adopted. In this chapter the scope of the assessment and the approach taken is set out in a structured manner and relevant assessment criteria have been identified from appropriate published sources, including values published by the Department of Health, the Environment Agency, the European Commission and the World Health Organisation.

- 18.1.9 The assessment of effects on health and well-being uses a qualitative methodology based on a logic framework to identify the links between proposed activities and potential impacts. These links represent pathways by which health and well-being may be affected. Where specific impacts on health have been reported in other chapters of this Environmental Statement that information is summarised within this chapter and then used within the assessment of effects on health and well-being.
- 18.1.10 Within Chapter 13: Air Quality, the significance of the changes in ambient concentrations of air pollutants, that sensitive receptors are exposed to, are assessed against National Air Quality Standards values set by national Government for the protection of human health (HM Government, 2000; HM Government 2002) and against other assessment criteria set by the Environment Agency (Environment Agency, 2010). Within this assessment the impact on health associated with changes in pollutant concentrations, that would meet regulatory requirements, are considered in greater detail. The assessment of well-being also considers the potential impact that may result from the perception of a risk to health or amenity, irrespective of the magnitude of the quantified air quality impacts.
- 18.1.11 Within Chapter 14: Noise and Vibration, the significance of acoustic (noise and vibration) impacts generated by the proposal is quantified and assessed against assessment criteria set by the Environment Agency and by Plymouth City Council. Within this assessment the impact on health and amenity associated with changes to existing conditions that would meet regulatory requirements, are considered in greater detail. The assessment of well-being also considers the potential impact that may result from the perception of a risk to health and amenity, irrespective of the magnitude of the quantified acoustic impacts.
- 18.1.12 Within Chapter 12: Transport Assessment, the assessment of significance includes consideration of the potential change in rates of motor vehicle-motor vehicle collisions and pedestrian-motor vehicle collisions. The assessment of well-being also considers the potential impact that may result from the perception of a risk to health, irrespective of the conclusions of the assessment accepted by the Transport Authority.
- 18.1.13 The EIA Scoping Opinion issued by Plymouth City Council did not specifically identify a need for an assessment of Health and Well-being although at a subsequent meeting the need for a human health risk assessment and consideration of well-being was raised. The Public Protection Service of Plymouth City Council and the NHS Plymouth have been consulted on the approach and methods used in the assessment of health and well-being effects.
- 18.1.14 The spatial scope of the assessment of effects on health and well-being extends to include all communities located close to the proposed facility or significantly affected links on the road network. Consideration of impacts associated with changes in air pollutant concentrations has been given to all communities within 10 km of the proposed chimney location.
- 18.1.15 The temporal scope of the assessment of effects on health and well-being reflects the nature of the impacts considered, with the proposed year of opening representing the main assessment scenario. For air quality related impacts annual risks and life time risks have been quantified as appropriate.
- 18.1.16 The Foresight Review on Mental Capital and Well-being (Foresight, 2009) defined well-being as,
- “... a dynamic state, in which the individual is able to develop their potential, work productively and creatively, build strong and positive relationships with others, and contribute to their community”.*

18.1.17 This assessment adopts the above definition of well-being. The assessment focuses on those impacts of the proposed development that are directly associated with air quality, acoustics (noise and vibration) or with road vehicle movements, and the potential for the impacts to affect social determinants of well-being. The social determinants considered are:

- control;
- resilience & community assets;
- participation; and
- inclusion.

18.2 Legislation and policy

Legislation

18.2.1 The Statutory Instrument under which this ES is submitted, is the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 (SI No. 293) (as amended). The assessment of health and well-being has been conducted within the scope of these regulations.

National Policy

18.2.2 Planning Policy Statement (PPS) 23: Planning and Pollution Control (ODPM, 2004) sets out some of the Government's core policies and principles on the most important aspects of land use planning. The document reiterates the Governments stated principles and approaches from 'A Better Quality of Life - A Strategy for Sustainable Development for the UK' that are of particular relevance to planning and pollution control.

18.2.3 Matters that may be material for consideration by planning authorities in taking decisions on individual planning applications are identified in Appendix A of PPS 23. The listed matters include the following that are of particular relevance to the assessment of human health and well-being:

- *"the possible effect of potentially polluting development (both direct and indirect) on land use, including effects on health, the natural environment and general amenity"*.
- *"the objective perception of unacceptable risk to the health or safety of the public arising from the development"*.

18.2.4 Whilst well-being is not explicitly mentioned in PPS 23, the objective perception of an unacceptable risk to the health and safety of the public is an aspect that has the potential to affect the well-being of concerned individuals. The perception of unacceptable risk is specifically identified in PPS 23 as being the objective perception of a risk and not the subjective perception of a risk.

Local Policy

18.2.5 The Marmot Review (Marmot, 2010) provided a national review of health inequalities and the social determinants of health, with a particular focus on areas needed to reduce health inequalities. In response to the Marmot review a Local Strategic Partnership with a Health Theme Group was set up in the Plymouth area. This partnership has developed the Plymouth

Health, Social Care and Well Being Strategy (NHS Plymouth, 2011b) to improve the health and well being of people in the City of Plymouth. The strategy sets out five key priorities which seek to address the inequalities of health and well-being, whilst promoting health issues.

18.2.6 Air quality, noise and road safety are not specifically referred to in the Plymouth Health, Social Care and Well Being Strategy (NHS Plymouth, 2011b). The five key priorities in this strategy are:

- to tackle health inequalities;
- to explicitly address inequalities in all plans through target setting, refocusing investment and rigorous use of equality impact assessment;
- to work in partnership to develop a plan to promote health, well being & social inclusion across the city;
- to directly address identified issues of access and take up of specified services; and
- promotion of integrated services to promote independence.

18.3 Baseline Conditions

Baseline Health and Well-being

18.3.1 Health profiles are produced annually by the Association of Public Health Observatories (APHO) and these provide a summary of the health of people within individual local authorities (APHO and Department of Health, 2010) and a comparison of local health with average values for all areas of England. Local average life expectancy does not differ significantly from the national average (see Table 18.1), although there are well documented health inequalities within the study area. Various factors contribute to an increase in the relative rates of deaths between summer and winter months (excess winter deaths). Excess winter death rates for the study area are not reported to be significantly different to the national average.

Table 18.1 Life Expectancy

Gender	Female Average (years ^a)	Male Average (years ^a)
England	82.0	77.9
Cornwall	82.8	78.7
Plymouth	82.0	77.2
South Hams	83.8	79.2
West Devon	84.2	79.1

^a values at birth (2006-2008) sourced from APHO and Department of Health, 2010.

18.3.2 Within the most deprived areas of Plymouth, average life expectancy for men is 7 years shorter than for men in the least deprived areas of Plymouth. The equivalent difference for women is 3 years.

18.3.3 The health of people in Plymouth as a whole is worse than the regional and national averages, but several measures of health have demonstrated year on year improvements over the last decade. The health of people within the study area, but outside of Plymouth, is generally better than the regional and national average. The rate of new cases of malignant melanoma skin

cancer in Plymouth, Cornwall, South Hams and West Devon are amongst the highest in England.

Table 18.2 Baseline Mortality Rates

Community	Health Outcome per 100,000 Population ^a			
	Deaths from smoking ^b	Early Deaths: heart disease and stroke ^c	Early Deaths: Cancer ^c	Road injuries and deaths ^d
England	206.8	74.8	114.0	51.3
Cornwall	187.9	67.2	108.9	46.7
Plymouth	221.8	82.3	117.7	25.7
South Hams	145.7	58.9	104.0	54.7
West Devon	138.7	60.1	92.5	54.4

^a sourced from APHO and Department of Health, 2010. ^b values expressed as per 100,000 population age 35+, directly age standardised rate 2006-2008 sourced from APHO and Department of Health, 2010. ^c values expressed as directly age standardised rate per 100,000 population under 75, 2006-2008. ^d values expressed as rate per 100,000 population 2006-2008.

18.3.4 The Director of Public Health picked up the theme of health inequalities, within Plymouth, in her Annual Report for 2010/2011 (NHS Plymouth, 2011a). The neighbourhoods located closest to the application site, namely Barne Barton, St. Budeaux and King’s Tamerton & Weston Mill, are identified as areas of poorer than average health and well-being. The need to address health and well-being related inequalities have been made a key priority area for action across all sectors within the city (NHS Plymouth, 2011b) with action proposed to improve baseline conditions on a scale that is proportionate to the level of disadvantage.

Baseline Air Quality

18.3.5 Air quality is generally of a good standard at relevant receptors located within 10 km of the proposed facility, as discussed in Chapter 13. Within Plymouth there are specific locations where Plymouth City Council have identified the risk of the annual mean nitrogen dioxide objective value of 40 µg/m³ being exceeded at a small number of residential properties (see section 13.3 of Chapter 13). At each of these locations road traffic emissions have increased annual mean concentrations of nitrogen dioxide above the objective value. These locations in Mutley Plain and Exeter Street are well away from the location of the proposed development as are the new Air Quality Management Areas (AQMA’s) which are being considered for designation in Tavistock Road in Crownhill, Stoke Village and Royal Parade.

18.3.6 Measured concentrations of all other air pollutants (section 13.3 of Chapter 13 and section 4.3 and 4.5 of Appendix 13.1) within the study area achieve ambient air quality standards set for the protection of human health by a large margin. Baseline air quality within the study area is of a good standard.

Baseline Noise Climate

18.3.7 Local communities are currently exposed to sounds from many sources. Measurements of noise levels at locations representative of surrounding residential properties were carried out to quantify the prevailing daytime and night-time noise climate (Chapter 14, Section 14.4). Noise can produce a range of social and behavioural effects in the residents of an affected community. The World Health Organisation uses a scale of low annoyance – moderate annoyance – serious

annoyance as an approach to represent the effect of noise on a community. The term “annoyance” is considered to represent a range of negative emotions including: anger, disappointment, dissatisfaction, withdrawal, helplessness, depression, anxiety, distraction, agitation or exhaustion (WHO 1980).

- 18.3.8 Current daytime noise levels are at or below the World Health Organization guideline value of 55 dB $L_{Aeq,16 \text{ hours}}$. This is a situation that few people would be seriously annoyed by. In addition the local topographical conditions enable residents at some properties in Barne Barton and St. Budeaux, to register isolated noises from single sources such as ship's tannoys and shouted conversations on the Dockyards. These isolated events have sometimes had an overt effect on residents' behaviour, including formal complaints being made to the local authority.
- 18.3.9 The night-time noise levels varied from night to night, with the majority of nights at or below the World Health Organization guideline value of 42 dB $L_{Aeq,8 \text{ hours}}$, for the onset of sleep disturbance (more recent WHO guidance proposes a criterion level of 40 dB $L_{Aeq,8 \text{ hours}}$).
- 18.3.10 Residential properties along the surrounding road network currently experience a range of daytime and night-time noise levels, depending on their location. It is likely that the WHO guideline values are exceeded at many of these properties, a situation which is not unusual in UK urban areas. The noise climate within the local community is currently such that it likely to cause residents low to moderate annoyance.

Baseline Road Safety

- 18.3.11 An assessment of the road safety in the immediate vicinity of the proposed development, including all routes that heavy goods vehicles use, is reported in Chapter 12. The assessment reports data provided by the transport authorities that shows that in five years there have been a total of 1 fatal accident, 9 serious accidents and 119 slight accidents on the road links within the study area for the transport assessment.

18.4 Methodology

Overview of Assessment Method

- 18.4.1 The impacts of the proposed development, that fall within the scope of this assessment, are considered to be generated by three distinct components of the project. These components as set out in Figure 18.1 are:
- Activities that would be undertaken during the construction phase of the project that have the potential to generate emissions of air pollutants, noise or vibration from the application site, or have the potential to generate additional vehicle movements on the road network.
 - Activities that would be undertaken during the operation of the EfW CHP facility that have the potential to generate emissions of air pollutants, noise or vibration from the application site, or have the potential to generate vehicle movements on the local road network.
 - The change in the routing and the volume of traffic on the road network resulting from the directing of waste to the EfW CHP facility instead of to other destinations. This includes the increase in heavy duty vehicle movements on roads local to individual receptors.
- 18.4.2 The project components cause changes to the baseline conditions of the affected neighbourhoods (proximal impacts). A direct outcome of the proximal impact might then in turn

result in an impact on the health or well-being of an individual or the wider community. These health and well-being impacts can be difficult to describe in detail and it may be more meaningful to describe them using specific quantifiable outcomes, such as the number of hospital admissions for a specific condition.

18.4.3 For example, the building of the facility creates a 95 m tall chimney through which the exhaust emissions from the combustion process would be emitted into the atmosphere. The stack does not emit any substances that are not already present in the receiving environment under baseline conditions, but the stack is a new source of emissions. Whether or not the new emissions could cause a significant health or well-being outcome, is dependent on the magnitude of the change to ambient air pollutant concentrations at the receptors and the sensitivity of the receptors to the change in air pollutant concentrations. Even if there is no demonstrable change in ambient concentrations of a pollutant, an individual's subjective perception of the risk to their health could cause anxiety or stress as an outcome.

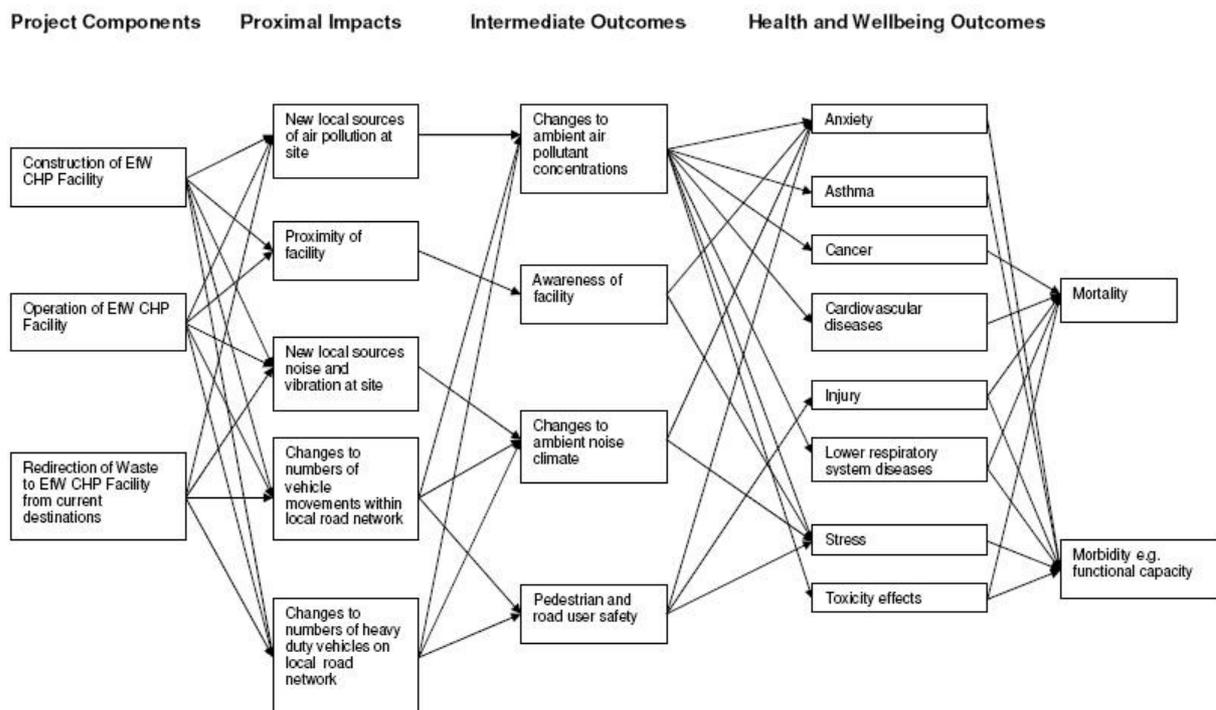


Figure 18.1 Logic Framework for Assessment of Health and Well-being Impacts

18.4.4 In order to assess the significance of the effect of each component of the project on health and well-being it is necessary to consider the relationships between the intermediate outcomes and the potential health and well-being outcomes in more detail. The existence of a pathway between a project component and a health and well-being outcome does not mean that the impact on that outcome must occur, nor that if an impact did occur that the effect must be significant.

18.4.5 The pathways and the magnitude of the impact on health outcomes are considered for each of the intermediate outcomes (see Figure 18.1). This is achieved by using quantitative information reported in other assessments, including:

- the magnitude of changes in ambient concentrations of air pollutants, as reported in Chapter 13: Air Quality of this Environmental Statement;
 - an assessment of health effects from exposure to particulate matter, nitrogen dioxide and sulphur dioxide, reported as Appendix 18.1 of this Environmental Statement;
 - an assessment of health effects arising from emissions of metals and organic substances, reported as Appendix 18.2 of this Environmental Statement;
 - the magnitude of changes in ambient noise levels and vibration levels as reported in Chapter 14: Noise and Vibration of this Environmental Statement; and
 - the magnitude of changes in road vehicle movements and accident statistics, as reported in Chapter 12: Transport Assessment of this Environmental Statement.
- 18.4.6 The pathways and the magnitude of the impact on well-being outcomes are not considered for each of the intermediate outcomes (see Figure 18.1) as quantitative baseline information is not available to support such an approach. Instead the assessment considers whether the proposed development and incorporated mitigation, would have a positive or negative effect on core protective factors for mental well-being. These factors have been identified by the National Mental Health Development Unit (NMH DU, 2010) as being:
- enhancing control;
 - increasing resilience and community assets;
 - facilitating participation; and
 - promoting inclusion.

Assessment methods for effects of intermediate outcomes

Changes to Ambient Air Pollutant Concentrations

- 18.4.7 The magnitude of changes in mean concentrations of air pollutants have been reported in Chapter 13 Air Quality, based on dispersion modelling of emissions from the EfW CHP facility and exhaust emissions from additional road vehicle movements generated by the operation of the facility. Changes in air pollutant concentrations are also reported in Chapter 13 for the construction phase activities. The overall conclusion of the air quality assessment is that local air quality will not be significantly affected by the construction or operation of the proposed EfW CHP facility and national air quality standards set for the protection of human health would be met at all relevant receptors in the communities most affected by the additional emissions.
- 18.4.8 In the UK, the process of setting air quality objective values has been driven by Directives from the European Commission (EC, 2008). The Clean Air for Europe (CAFE) programme developed assessment methods that allow the public health effects of changes in the level of exposure of populations to air pollutants to be calculated, for ambient concentrations at which individuals would not be expected to exhibit direct effects. These methods underpinned the process of defining the health based air quality standards (limit values and target values) adopted in the Ambient Air Quality and Cleaner Air for Europe Directive 2008/50/EC (EC, 2008).
- 18.4.9 This assessment has adapted the quantification methodologies developed by the Department of Health Committee on the Medical Effects of Air Pollution (COMEAP) and Clean Air for Europe (CAFE) programme to assess the public health effects resulting from exposure to sulphur dioxide (SO₂), nitrogen dioxide (NO₂) and two size fractions of particulate matter (PM₁₀ and

PM_{2.5}) as a result of main stack emissions from the EfW CHP facility. Chapter 13 has considered the effect of exposure of individuals to changes in pollutant concentrations by using the air quality objective values as assessment criteria. The assessment, set out in Appendix 18.1, considers effects on health at the population level for a study area extending 10 km from the location of the proposed main stack.

- 18.4.10 For a given change in the ambient concentration of PM_{2.5} that the population are exposed to there is an associated change in the risk that the exposure will result in a decrease in life expectancy, or loss of life. The risk of mortality effects is expressed as an estimate of life years lost by the total population. For acute health effects the pollutant concentrations predicted by the dispersion model exercise (Appendix 13.1) are combined with the population data using GIS software and the necessary data extracted for use in the calculation of health outcome statistics. The methods used are described in full in section 2 of Appendix 18.1.
- 18.4.11 The acute health effects associated with exposure of the total population to particulate matter that are considered in this assessment as specific outcomes or events are:
- Chronic bronchitis (adults);
 - Respiratory hospital admissions;
 - Cardiac hospital admissions;
 - Lower respiratory system symptom days (children); and
 - Lower respiratory system symptom days (adults).
- 18.4.12 The health effects associated with exposure to nitrogen dioxide that are considered in this assessment as specific outcomes or events are:
- Respiratory hospital admissions;
 - Cardiac hospital admissions; and
 - Mortality.
- 18.4.13 Acute mortality and respiratory hospital admissions from NO₂ should be considered as an alternative to that used for particulate matter and not in addition. This is because NO₂ may be acting as a marker for the effect of locally emitted particulate matter (COMEAP, 2009) and there is therefore a risk of double counting the impact of local emissions on health. Likewise mortality and respiratory hospital admissions associated with SO₂ should not be added, as there may be some synergistic effects, i.e. the observed associations are not independent of each other.
- 18.4.14 Health effects associated with exposure to sulphur dioxide that are considered in this assessment as specific events are:
- Respiratory hospital admissions; and
 - Mortality.
- 18.4.15 The Human Health Risk Assessment (HHRA) method is based on the application of the US EPA Human Health Risk Assessment Protocol (HHRAP) (US EPA, 2005) and is an internationally recognised approach to the quantifying the potential effect on individual receptors from long term, cumulative exposure to dioxins, furans and metals. The HHRAP refers to these pollutants as compounds of potential concern (COPCs) and this phrase has been used in the assessment

of Health Effects arising from Emissions of Metals and Organic Substances included as Appendix 18.2 of this Environmental Statement.

- 18.4.16 This assessment considers the effects on the human health of the local population when exposed to emissions from the proposed EfW CHP facility by using a number of different methods. The IRAP model (REF) has been used to calculate exposure concentrations and average daily doses experienced at each individual hypothetical receptor from the output from the dispersion model exercise (Appendix 13.1). Instead of considering real people as receptors the assessment adopts a more conservative approach based on four receptor types that represent hypothetical exposure scenarios. The hypothetical resident and resident's child receptor types, represent people that remain at the location within an urban area with the maximum level of exposure to COPCs for every moment of 50 weeks of every year of their life and consume a proportion of home grown produce. The hypothetical farmer and farmer's child remain at the location outside of an urban area with the maximum level of exposure to COPCs for every moment of 50 weeks of every year of their life and consume mostly home grown produce, including home grown meat.
- 18.4.17 Full details of the receptor types and exposure scenarios are provided in section 2.4 of Appendix 18.2. The location of the receptors representing maximum levels of exposure within selected urban and rural communities are illustrated in Figure 2.1 of Annex A in Appendix 18.2.
- 18.4.18 The exposure of hypothetical receptors to metals and dioxin/furans from the proposed EfW CHP facility, via concentrations in soil and in the diet of the local population, is considered by comparison to relevant standards and typical dietary values. The human health effect of the additional dioxin/furan concentrations associated with the emissions from the proposed EfW CHP facility are assessed by comparison with the Tolerable Daily Intake criteria derived by the World Health Organisation (WHO, 1998) and the UK's Committee on Toxicology (COT, 2001). A separate exposure pathway is used to assess the infant exposure to dioxin/furans via the mother's breast milk by comparison to the literature values (US EPA, 2005).
- 18.4.19 The average dose of each COPC received by a receptor, via both the ingestion and inhalation pathways, is compared to a reference dose below which there is no appreciable risk of adverse health effects. Hazard index values are calculated in this way to represent the risk of the non-carcinogenic effects on human health being experienced by a receptor exposed to the COPCs via a single pathway. A total hazard index is then calculated by combining the risks from exposure to COPCs via all pathways.
- 18.4.20 Carcinogenic risk associated with exposure to the emissions from the proposed EfW CHP facility is calculated in terms of the excess lifetime risk of a hypothetical receptor developing cancer for each COPC via the inhalation or ingestion pathways. This is done by multiplying the exposure concentration by a particular factor that takes into account the risk of developing cancer, based on a dose response relationship that HHRAP has adopted from the medical literature. The excess lifetime cancer risk is calculated for the exposure of each hypothetical receptor to the COPCs via a single pathway at a single receptor. The total excess lifetime risk of developing cancer at a single receptor takes into account the risks associated with all the relevant COPCs via all the relevant pathways.
- 18.4.21 The assessment methodology has deliberately used assumptions to generate scenarios that will lead to the over-estimation of the risks to human health. Such conservative assumptions include the duration and frequency of exposure to an individual i.e. they are assumed to live their entire lives in the area of maximum impact and that a significant portion of their diet is obtained from

animal and vegetable products grown/reared in the local area where deposition occurs, whereas in reality it will originate from further afield. Taking into account the conservative nature of this assessment, if it can be concluded that a maximally exposed hypothetical individual receptor would not be subject to a significant risk of carcinogenic and non-carcinogenic health effects from exposure to COPCs via the inhalation and ingestion pathways, then it can be concluded with confidence that actual receptors would not be at significant risk of these health effects.

Awareness of Facility

- 18.4.22 The physical presence of the proposed EfW CHP facility at North Yard would be apparent to those residents of the local communities for the operational lifetime of the plant. This aspect of the assessment does not seek to duplicate the Landscape and Visual assessment reported in Chapter 8 of this Environmental Statement. This assessment acknowledges the existence of a relationship between the physical presence of the EfW CHP facility or the applications to build and operate it and the potential for members of the local community to perceive adverse effects on public health that may or may not be supported by available objective evidence (COMEAP, 2000). Such perceptions can increase levels of stress and anxiety for the affected individuals, and as such represent an adverse health and well-being outcome.
- 18.4.23 The potential impact of people's awareness of the facility on their perception of effects on public health is not assessed, but incorporated mitigation measures that aim to minimise the effects of the decision making process and the operation of the proposed facility on the core protective factors for mental well-being are considered.

Changes to Ambient Noise Climate

- 18.4.24 Construction noise predictions have been reported in Chapter 14, based on the methodology outlined in BS 5228-1: 2009 'Code of practice for noise and vibration control on construction and open sites. Part 1: Noise'. BS 5228 predicts noise as an equivalent continuous noise level averaged over a period such as 1 hour ($L_{Aeq,1h}$). Estimated construction noise levels have been assessed against the limit values in Plymouth City Council's Code of Practice on the Control of Pollution and Noise from Demolition and Construction Sites.
- 18.4.25 Ground vibration levels due to specific construction works have been estimated at sensitive receptors using example measured source data and the appropriate propagation relationship taken from BS 5228-2: 2009 'Code of practice for noise and vibration control on construction and open sites. Part 2: Vibration'. Estimated construction vibration levels have been assessed against the limit values provided in BS 5228-2.
- 18.4.26 For operational noise, a noise propagation model has been developed in the SoundPLAN suite of programs, which implements a range of calculation methods, including the ISO 9613-2 calculation method for industrial noise sources, which is applicable to this development.
- 18.4.27 The model consists of a detailed three dimensional representation of the proposed facility and the surroundings and has been employed to calculate noise levels at surrounding sensitive receptors due to noise breakout from the facility buildings, noise emission from external sources and noise emission from HGVs on site. Estimated operational noise levels have been assessed against the prevailing ambient and background noise levels at surrounding sensitive receptors.
- 18.4.28 Ground vibration levels due to operation of the facility will be negligible as there are no significant sources of vibration present during the operational phase.

18.4.29 Changes to the level of annoyance that the noise climate in the local community can reasonably be expected to cause residents, is identified relative to baseline conditions, for both the construction and operation of the proposed facility. Two specific criteria are used to determine levels of annoyance and these are:

- the current World Health Organization guideline values as dB $L_{Aeq,16 \text{ hours}}$ for daytime noise levels; and
- the current World Health Organization guideline value as dB $L_{Aeq,8 \text{ hours}}$ for night-time noise levels.

Pedestrian and Road User Safety

18.4.30 The magnitude of changes in accident statistics have been assessed in accordance with the Department for Transport's (DfT) latest guidance on the preparation of Transport Assessments (2007). Personal injury incident data was sourced for the most recent five year period available and provides details of the location, severity and description of road traffic incidents.

18.5 Incorporated Mitigation

Mitigation of Emissions to Air

18.5.1 The proposed EfW CHP facility would be regulated under a permit issued by the Environment Agency, under the Environmental Permitting Regulations (H.M. Government, 2010). The permit would as a minimum require emissions of air pollutants to be controlled to achieve limit values defined in the Waste Incineration Directive (Table 3.3 in Appendix 13.1). Physical abatement techniques, as described in section 13.5 of Chapter 13, would be used to ensure the required level of performance was achieved.

18.5.2 The effective control of emissions at source is the best available method of ensuring that emissions do not result in significant impacts on health outcomes.

Mitigation of Noise and Vibration

18.5.3 The proposed EfW CHP facility would be regulated under a permit issued by the Environment Agency. The permit would as a minimum require noise to be controlled to achieve limit values based on the prevailing background noise levels. Different limit values apply for daytime and night-time.

18.5.4 The same approach is adopted by Plymouth City Council who are aware of the baseline noise climate within the study area. A Rating Level (as defined in BS4142) no more than 5 dB(A) above the minimum background noise level will be required.

18.5.5 Physical abatement techniques, as described in Section 14.5 of Chapter 14, would be used to ensure the required level of performance was achieved. Tonal characteristics to the plant noise emission have been avoided by the careful selection of plant. The effective control of noise and vibration at source is the best available method of ensuring that emissions do not result in significant impacts on health outcomes.

18.5.6 During the construction phase, limits on hours of working would remove the potential for adverse impacts on amenity by removing the potential for noise to be generated by works or site vehicles.

Normal working hours during the construction period are anticipated to be 08:00 to 18:00 on weekdays and 08:30 to 13:00 on Saturdays.

- 18.5.7 During the operational phase deliveries would only be accepted between the hours of 08:00 and 19:00 on weekdays, 08:00 to 18:00 on Saturdays and 08:00 to 16:00 on Sundays.
- 18.5.8 Good site practices will be employed to minimise operational noise levels. In particular, the type and use of reversing alarms to site vehicles will be carefully controlled.

Mitigation for Pedestrian and Road User Safety Purposes

- 18.5.9 The assessment of road safety, within Chapter 12 of this Environmental Statement, concluded that no mitigation of the surrounding road network is required.

Mitigation of Perceived Impacts

- 18.5.10 It is not possible to apply any physical abatement measures that can be relied upon to mitigate an individual or community's perception of a hazard and the associated risk to health and well-being. Research commissioned by the Environment Agency (Environment Agency, 2009) explored the reasons why people may have a distrust of conventional science and expert evidence within the decision making process. Measures that help people to understand what is proposed, how conclusions about potential effects have been arrived at, and how their concerns are taken into account were identified as being beneficial.
- 18.5.11 The following measures have been adopted to assist members of the local communities to engage more effectively and more easily in the decision making process:
- The Local Liaison Committee (LLC) composed of members of the local community and representatives of the local authority, MVV and other relevant government bodies;
 - stakeholder consultation events at venues within the local communities at multiple stages in the planning application process;
 - multiple events to maximise opportunities for stakeholders to attend;
 - presence of independent experts at public exhibitions to respond in person to technical questions raised about impact assessment methods and conclusions;
 - a community involvement statement; and
 - preparation of a separate chapter on health and well-being within the Environmental Statement.
- 18.5.12 The following measures will be adopted to promote control, inclusion and participation of members of the local communities in the operation of the facility:
- Inclusion of an education centre;
 - The Local Liaison Committee;
 - Air pollution measurement data for the facility will be reported on a publicly accessible website on a weekly basis to enable comparison of actual emissions against permitted limits; and
 - Regular noise measurement data will be reported on a publicly accessible website to enable comparison of actual levels against permitted limits.

18.6 Impact Assessment

Overview

- 18.6.1 This section considers the potential impacts during the construction phase of the scheme and then the potential impacts during the operational phase of the scheme. For each phase the health effects of impacts on the community noise climate and road safety are considered by reference to information reported in Chapter 14 and Chapter 12 respectively. The health effects of changes in air pollutant concentrations and the associated deposition of pollutants draw on information reported in Chapter 13, and then consider the effects in more detail based on the technical reports presented as Appendix 18.1 and Appendix 18.2.
- 18.6.2 The effect of the proposed development on well-being is also considered for both phases of the project.

Impacts during the Construction Phase

Health Effects Arising from Changes in Air Pollutant Concentrations

- 18.6.3 There are a number of potential dust generating activities at the proposed development site during the construction phase. A dust management plan, agreed with the local authority air quality/pollution control officer, defines the actions that can reasonably be taken to mitigate impacts should they occur, as well as in defining routine controls and checks to be employed.
- 18.6.4 During each phase of the works, if dust generating activities are subject to standard dust suppression measures (included within the dust management plan) and of the type normally associated with sites operating under the Considerate Contractor Scheme or similar, then the impacts on residential receptors would be small under normal atmospheric conditions, producing an effect of negligible significance.
- 18.6.5 If residential properties experience an occasional increase in local soiling rates during times when activities are carried out in extremely dry and windy weather, any such impacts would be restricted to short-term episodes affecting a small number of properties and would be of minor significance. These impacts are most likely to take the form of increased soiling of property surfaces and are not normally associated with a general risk to health.

Health Effects arising from Vibration or Changes in the Noise Climate

- 18.6.6 Construction is by its very nature a temporary process. Whilst surrounding residential properties will experience elevated noise levels when compared to the prevailing ambient noise levels, people are much more tolerant of temporary effects, particularly if there is good communication between the contractors and themselves. For much of the construction period, when construction activities are being carried out at considerable distances from particular groups of residential properties, the resultant noise levels would not be sufficiently noticeable to cause an increase in annoyance above baseline levels.
- 18.6.7 Estimated ground vibration levels at surrounding residential properties during construction works are reported in Chapter 14 to be negligible, and are unlikely to be noticed by residents. People can become concerned about vibration levels to their properties at orders of magnitude below the levels that may cause even cosmetic damage. Therefore if for some reason the method or location of construction works, such as piling, is changed, good communication between the contractor and residents will be used to that help people to understand what is proposed, how

conclusions about potential effects have been arrived at, and to enable their concerns to be taken into account.

18.6.8 Construction works will only be carried out during the daytime period. Consequently, for the majority of residents, there will be no potential for night-time sleep disturbance in addition to the potential present under the baseline conditions. There is however, the potential for short-term, temporary sleep disturbance for shift workers.

18.6.9 Overall, the noise levels that the local community would be exposed to during the construction phase of the project, as reported in Chapter 14, would not be sufficiently noticeable to cause an increase in the level of annoyance above the baseline condition of low to moderate annoyance. No significant effect on health is likely to occur as a result of the predicted impact on community noise levels during the construction phase.

Effects on Well-being

18.6.10 The construction of the proposed facility could have an effect on well-being through the impact on air quality, noise and traffic in the local area. The mitigation measures included as part of the individual assessments on noise, air quality and transport and also those on the perceived impact of the facility will reduce to a minimum any impact that the construction of the proposed facility will have on the intermediate outcomes. The mitigation measures seek to promote a positive effect on the social determinants of well-being throughout the construction phase of the facility.

Impacts during the Operational Phase

18.6.11 The impacts on health during the operation of the proposed facility has been considered within the individual assessments (Appendix 18.1 and 18.2) and are summarised below.

Assessment of Health Effects from Exposure to Particulate Matter, Nitrogen Dioxide and Sulphur Dioxide

18.6.12 The Assessment of Health Effects from Exposure to Particulate Matter, Nitrogen Dioxide and Sulphur Dioxide (see Appendix 18.1) concluded that, for each pollutant under consideration, the effect of the proposed EfW CHP facility emissions of particulate matter (PM₁₀ and PM_{2.5}), oxides of nitrogen and sulphur dioxide on human health would be relatively small.

18.6.13 The main outcomes of this assessment are as follows:

- Averaged out across the whole exposed population 1.38 minutes per person of life would be lost through exposure to the maximum concentration of PM_{2.5}, which is an alternative way of expressing the impact of - 0.70 years of exposed population life. By comparison, in 2010 COMEAP (COMEAP, 2010) calculated that the mortality effects of long term exposure to particulate air pollution to be equivalent to 29,000 deaths in the UK associated with a loss of total population life of 340,000 years and a loss of life expectancy from birth of approximately 6 months.
- The estimated number of extra chronic bronchitis events, associated with the predicted change in concentration of particulate matter in the study area, is 0.12 per annum, which represents 0.006% of the corresponding baseline rates predicted for the entire exposed population. Additional cases of hospital admissions for cardiovascular and respiratory symptoms are predicted to rise by 0.02 per annum. The estimated increase in the occurrence of lower respiratory symptoms in children is 0.03 events per annum, which

represents a 0.00003% increase on predicted baseline rates. This not considered to be significant effect on the health of the exposed population as a whole.

- Rates of hospital admissions for cardiovascular symptoms, associated with the predicted change in concentration of nitrogen dioxide in the study area, are estimated to increase by 0.56 per annum, which represents 0.015% of the corresponding predicted baseline rates for the entire exposed population. This is considered insignificant when compared to the total incidence of heart disease in the entire population of England, attributable to factors such as, diet and lifestyle. The estimated increase in hospital admissions for respiratory symptoms are predicted to increase by 0.004% on a baseline rate of 2,072 admissions per year. The predicted impact for the measure death brought forward is an increase of 0.004% on a predicted baseline rate of 2,043 deaths brought forward per annum.
- The predicted impact for the measure death brought forward, associated with the predicted change in concentrations of sulphur dioxide in the study area, is an increase of 0.003% on a predicted baseline rate of 2,043 deaths brought forward per annum. Rates of hospital admissions for respiratory symptoms are estimated to increase by 0.04 per annum, which represents a 0.002% increase of baseline rates. The change in sulphur dioxide concentrations due to the proposed EfW CHP facility can be considered as a relatively small effect on the health of the exposed population.

18.6.14 The assessment of particulate matter considers the size fractions known as PM₁₀ and PM_{2.5} on the basis of the mass of particulate matter suspended in a volume of air, i.e. as a mass concentration. The mass concentration values for PM₁₀ includes the mass of smaller particles that also form part of the PM_{2.5} value, which in turn includes the mass of smaller size fractions such as PM_{0.1}. The size fraction of particulate matter represented by PM_{0.1} are also referred to as nanoparticles.

18.6.15 Within the research community one area of active investigation is whether the use of particle counts would provide better dose response relationships than the current approaches based on mass concentrations of particulate matter. The possibility is that if nanoparticles are disproportionately important in defining dose response relationships, then particle counts would provide an alternative method of defining the abundance of material in this size fraction. As current regulations (H.M. Government, 2000 & 2002) are framed in terms of mass concentrations of PM₁₀ and PM_{2.5}, these are the only impacts considered in this assessment. It is noted that the HPA have stated the view (HPA, 2010) that *“it is unreasonable to expect local health professionals to interpret number concentrations in quantitative health terms when national experts have not yet judged that the evidence is sufficient to do so”*.

Health Effects arising from Emissions of Metals and Organic Substances

18.6.16 The possible impacts on human health arising from dioxins and furans, PAHs and trace metals emitted from the proposed EfW CHP facility have been assessed under the hypothetical scenario of receptors exposed for their lifetime to the effects of the highest airborne concentrations and consuming mostly locally grown food. The full results of the study are presented in the assessment report in Appendix 18.2.

18.6.17 Deposition and subsequent uptake of the Compounds of Potential Concern (COPCs) into the food chain is likely to be a more numerically significant pathway than direct inhalation for the majority of receptor scenarios considered. This reflects the potential for COPCs to bio-accumulate through the food chain and the assessment methods employed take a conservative approach to the assessment of the associated risks.

- 18.6.18 The Total Hazard Index for each receptor represents the cumulative risk of non-carcinogenic health effects from exposure to each compound of potential concern, via each exposure pathway. The values calculated by IRAP are reported for each urban and rural community in section 3.2 of Appendix 18.2. If a Total Hazard Index value is equal to 1.0 it means that the receptor is predicted to be exposed to COPCs at the lowest doses that studies have observed any appreciable non-carcinogenic effect on health. A Total Hazard Index value of less than 1.0 indicates that any non-carcinogenic effect on health exists, it is likely to be so slight as to pass unnoticed.
- 18.6.19 For all of the receptor scenarios the Total Hazard Index values at all locations are substantially lower than 1.0. This means that exposure of the local population to emissions of metals from the proposed EfW facility are very unlikely to cause a significant effect on the health of any individual.
- 18.6.20 The hypothetical resident type receptors located in the Plymouth urban area at the point of maximum impact are the child and adult receptor types at location PL2. The total Hazard Index at PL2 of 0.097 for the resident's child receptor type and the corresponding value for the resident adult at PL2 is 0.051. The total hazard index values for all other locations within the City of Plymouth, including Plympton and Plymstock, are lower than for location PL2, as annual mean atmospheric concentrations of airborne pollutants and mean pollutant deposition rates would be highest at location PL2. Impacts this small are highly unlikely to have a significant non-carcinogenic effect on the health of any adult or child within the Plymouth urban area.
- 18.6.21 The hypothetical farmer type receptors located at RNW2, between Saltash and Torpoint represent the point of maximum impact at any rural location in Cornwall or South Hams. The total Hazard Index for the farmer's child type receptor at location RNW2 of 0.048 and the corresponding value for the farmer adult at RNW2 is 0.037. The total Hazard Index for the maximum exposed hypothetical resident type receptor in Saltash (SA1) is 0.003. As actual residents of rural communities are likely to consume a significant proportion of their diet from local shops, impacts on receptors located in Cornwall and South Hams can reasonably be considered to be better represented by impacts reported by receptor SA1 than the more extreme scenario of RNW2. Impacts this small are highly unlikely to have a significant non-carcinogenic effect on the health of any adult or child living at any rural location or urban area outside the City of Plymouth.
- 18.6.22 The additional lifetime carcinogenic risk to a receptor arising from inhalation and ingestion of compounds of potential concern have been assessed using US EPA cancer potency factors and unit risk factors. Risk estimates can be a difficult metric for the general public to relate to their every day experience. As a point of reference, a life time risk of 1 in 14,300 is equivalent to an annual risk of 1 in 1 million for a lifetime of 70 years. The life time risk estimates (70 year period) are reported in section 3.3 of Appendix 18.2, for hypothetical individuals exposed to the highest airborne concentrations and consuming mostly locally grown food are:
- a total lifetime risk of 1 in 1 million & an annual risk of 1 in 68 million for the hypothetical resident (adult) receptor type at location PL2 in Plymouth;
 - a total lifetime risk of 1 in 1 million & an annual risk of 1 in 59 million for the hypothetical resident (adult) receptor type at location SA1 in Saltash; and
 - a total lifetime risk 1 in 1 million & an annual risk of 1 in 1 billion for the hypothetical farmer (adult) receptor type at location RNW2, between Saltash and Torpoint.

- 18.6.23 The risks associated with the operation of the facility, for an individual living a 70 year lifetime in the study area would be significantly smaller than the total lifetime risk of carcinogenic health effects of 1 in 1 hundred thousand considered acceptable by the US EPA and the annual risk of 1 in 1 million, considered acceptable for industry within the UK.
- 18.6.24 The risk of the operation of the EfW CHP facility resulting in carcinogenic health effects at any location inside or outside the City of Plymouth is very low. These predictions are in keeping with the observations of the expert advisory committee, the Committee on the Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COC) that on the basis of a study of 14 million people living within 7.5 km of 72 municipal incinerators in Great Britain (Elliott et al.), that any potential risk of cancer due to residency near to municipal solid waste incinerators was exceedingly low (COC, 2000).
- 18.6.25 The assessment of human health effects has demonstrated, through the application of an internationally accepted assessment method, that the maximally exposed individual would not be subject to a significant risk of carcinogenic or non-carcinogenic health effects as a consequence of being exposed to pollutants emitted to air from the proposed facility.

Health Effects arising from Changes to Noise Climate

- 18.6.26 The detailed computer model for the operation of the plant has been employed to calculate daytime and night-time resultant noise levels at the surrounding residential receptors. The significance of the calculated noise levels has been assessed in two ways:-
- Comparison with the existing minimum background noise levels (for day and night periods)
 - Comparison with the existing daytime and night-time ambient noise levels
- 18.6.27 For comparison with the existing background noise levels, the predicted daytime noise levels from the plant have been adjusted for the character of the noise (in particular, the irregular changes in noise level due to HGV movements) by the addition of 5 dB(A) to derive a Rating Level at all receptors. This Rating Level has been compared to the existing minimum daytime background noise level. At all receptors, the Rating Level was at, or below, the target noise levels, which were set at 5 dB(A) above minimum background level.
- 18.6.28 During the night-time period there will not be any HGV movements on site. Additionally, noise from the operation of the plant itself will be steady and broadband in nature. Consequently, no adjustment has been made to the predicted night-time noise levels and the Rating Level is equal to the predicted noise level at all receptors. At all receptors, the Rating Level was at, or below, the target noise levels, which were set at 5 dB(A) above minimum background level.
- 18.6.29 For comparison with the existing daytime ambient noise levels, the predicted noise levels for plant operation have been combined with the existing noise levels to derive resultant daytime and night-time ambient noise levels with the plant in operation. The increases in ambient noise levels as a result of the plant operation have then been determined.
- 18.6.30 For the daytime period, the noise increases at all surrounding residential properties are at or below 1 dB(A). Considering these small noise increases and the absolute noise levels during the daytime period (compared to WHO criteria), it is unlikely that operation of the EfW plant will have a significant effect on the level of annoyance experienced by residents in the vicinity.

- 18.6.31 For the night-time period, the noise increases at surrounding residential properties range from 0 to just over 2 dB(A). At those properties where the increases are in the region of 2 dB(A), the change in ambient noise level may be perceptible.
- 18.6.32 The night-time noise levels, with the plant in operation, are in the range 41 to 43 dB(A), which are at, or just above, the WHO criterion level for sleep disturbance. Considering the low noise increases due to plant operation and the absolute noise levels during the night-time period (compared to WHO criteria), the baseline level of annoyance due to community noise can reasonably be expected to remain unchanged for local receptors at a low to moderate level of annoyance.
- 18.6.33 Overall the predicted impacts of the operation of the proposed facility, including associated additional vehicle movements on the noise climate of the affected communities, would not result a significant change in annoyance. This in turn represents no effective change to baseline health or well being as a direct result of impacts to the baseline noise climate.

Health Effects arising from Road Traffic Movements

- 18.6.34 Chapter 12 of the Environmental Statement reports that development traffic would not significantly affect the experience of pedestrian and other road users as the external road network has the capacity to accommodate the additional vehicle movements without changes being required by the transport authority.
- 18.6.35 The existing provisions made for pedestrians in the form of crossing points and guard rails would minimise the 'fear and intimidation' effect of additional heavy goods vehicle movements. At Weston Mill Drive between Carlton Terrace and Wolseley Road the school is separated from the highway by a fence along the boundary. The transport assessment did not report any significant effects relating to pedestrian or road user safety.

Effects on Well-being

- 18.6.36 The intermediate air pollution, acoustic and road traffic outcomes associated with the operation of the proposed EfW CHP facility would not have a significant effect on health of the local communities of Barne Barton, St. Budeaux, King's Tamerton & Weston Mill or any population located further from the application site.
- 18.6.37 The perception of significant adverse effects on public health may be held by some individuals. This is more likely if the individual does not trust the decision making process, the independence or reliability of the evidence of health effects made available then they are more likely to place increased weight on their own subjective perception of the situation. This perspective is likely to be reinforced if the individual feels excluded from the decision making process and or is personally disadvantaged by the proposal in any way.
- 18.6.38 The mitigations measurements incorporated into the design and operational stages of the proposed facility including the local liaison committee, education centre and publication of environmental monitoring data can be reasonably considered to promote inclusion and participation by stakeholders and this in turn could promote a feeling of control. The mitigation is not intended to alter residents' opinions about the proposed scheme in the wider sense, but will provide additional means for residents and other stakeholders to access objective information and to make their views heard.
- 18.6.39 A wide range of initiatives for improving the baseline level of well being in the communities surrounding the application site are included within Plymouth's Health, Social Care & Well-being

Strategy 2008-2020. The proposed scheme would not significantly affect local air quality, community noise climate or pedestrian & road user safety. The proposed scheme is highly unlikely to interfere with the successful implementation of any of the measures in Plymouth's Health, Social Care & Well-being Strategy that are intended to address priority health and well-being inequalities within Plymouth and therefore the effect of the scheme (with incorporated mitigation) on well-being is considered to be negligible.

18.7 Additional Mitigation

- 18.7.1 At this time no mitigation beyond the measures already incorporated in the scheme (See Section 18.5) are proposed. However, the community engagement elements of the mitigation are intended to be a two way process and additional mitigation measures might be generated by this dialogue.
- 18.7.2 For the purposes of the assessment of residual effects on health and well-being no additional mitigation measures have been considered.

18.8 Residual Effects

- 18.8.1 Dispersion modelling has been used to quantify the magnitude of the impacts at receptors due to emissions from the proposed EfW CHP facility. Emissions from the facility and additional road traffic exhaust emissions during both the construction and operational phase would not result in a significant impact at any air quality sensitive receptors.
- 18.8.2 The assessment of the effect of EfW CHP facility emissions of SO₂ NO_x PM₁₀ and PM_{2.5} on human health, using the COMEAP and CAFE assessment methods (Appendix 18.1), has demonstrated that these impacts do not represent a significant effect on health. In addition the Human Health Risk Assessment (Appendix 18.2) has quantified the carcinogenic and non-carcinogenic risk to human health from exposure of the local community to emissions of elemental (Sb, As, Cd, Cr, Hg, Pb and Ni) and organic (PCDD/F congeners and B[a]P) compounds of potential concern. The HHRA demonstrates that the additional risk to human health associated with the predicted magnitude of additional exposure to these COPC resulting from the operation of the EfW CHP facility would not be a significant effect.
- 18.8.3 The effects on human health predicted for the proposed EfW facility, as a result of emissions of pollutants to air, are in keeping with the low level of risk to health that Defra and the Health Protection Agency have identified as being achievable by modern well managed EfW facilities in the UK.
- 18.8.4 With adherence to good site practices, residual construction noise and vibration effects are assessed as negligible / low and it is unlikely that construction noise and vibration will have any significant impact on the health of surrounding residents.
- 18.8.5 Operational noise levels at surrounding sensitive receptors are at, or below, the world health organisation's target noise levels. Mitigation has been designed into the plant to reduce operational noise levels as far as is practicable.
- 18.8.6 Operational noise and vibration health effects are assessed as negligible for the daytime period and as negligible / low for the night-time period. The predicted change in noise levels would not be large enough to cause a change in the level of annoyance within the local communities.

Community noise would be characterised by a low to moderate level of annoyance with or without the proposed scheme and would not therefore have a significant effect on health or well being.

- 18.8.7 The Planning and Environmental Permitting regime provides the mechanism by which the controls will be put in place and enforced, to ensure that the EfW CHP facility is operated in a manner that would not result in significant effects on human health as a result of noise and vibration and emissions to air.
- 18.8.8 No mitigation measures have been proposed for the road network and therefore the impacts from road traffic will be as reported in Section 18.6.
- 18.8.9 The proposed scheme is highly unlikely to interfere with the successful implementation of any of the measures in Plymouth's Health, Social Care & Well-being Strategy that are intended to address priority health and well-being inequalities within Plymouth and therefore the effect of the scheme (with incorporated mitigation) on well-being is considered to be negligible.

Cumulative Effects

- 18.8.10 The traffic data used for the transport and road traffic impact assessment includes other developments in the local area and therefore takes into account the cumulative impact of future developments on the impact of health from road traffic.
- 18.8.11 Other specific developments within the local area including the housing regeneration project in North Prospect, the Plymouth life centre on Outland Road and the delivery of a new district centre, to include retail, community and residential units, at Weston Mill will seek to separately improve the health and well-being of the local population. The cumulative effect of these developments and the incorporated mitigation measures within the design of the proposed EfW CHP facility has the potential to improve the overall health and well-being of the local population.

18.9 Conclusion

- 18.9.1 This chapter identifies potential impacts of the operation of the proposed EfW CHP facility, on the health and well-being of local communities, that are directly associated with air quality, acoustics (noise and vibration) or with road vehicle movements. The significance of the effect on human health and well-being of these impacts has been assessed.
- 18.9.2 Emissions to air from the facility and additional road traffic exhaust emissions during both the construction and operational phase have been assessed using a detailed quantitative method. The predicted pollutant concentrations reported in Chapter 13 would not result in a significant effect at any air quality sensitive receptors.
- 18.9.3 Emissions to air from the facility would not result in a significant impact at air quality sensitive receptors within 10 km of the proposed EfW CHP facility. The assessment of the effect of the emissions of SO₂ NO_x PM₁₀ and PM_{2.5} on human health, using the COMEAP and CAFE assessment methods, has demonstrated that predicted impacts do not represent a significant effect to the local population. In addition the HHRA has quantified the carcinogenic and non-carcinogenic risk to human health from exposure of the local community to emissions of elemental (Sb, As, Cd, Cr, Hg, Pb and Ni) and organic (PCDD/F congeners and B[a]P) compounds of potential concern. The HHRA demonstrates that the additional risk to human

health associated with the predicted magnitude of additional exposure to these COPC resulting from the operation of the EfW CHP facility would not be a significant effect.

- 18.9.4 The effects on human health predicted for the proposed EfW facility, as a result of emissions of pollutants to air, are in keeping with the low level of risk to health that Defra and the Health Protection Agency have identified as being achievable by modern well managed EfW facilities in the UK.
- 18.9.5 The construction and operation of the proposed EfW CHP facility has the potential to impact on the on the social determinants of mental well-being. The mitigation measures incorporated into the design and operational stages of the proposed facility, including those to reduce the impact of emissions to air, noise and vibration, road traffic and the perceived impact of the facility, seeks to have a positive impact on well-being. Other developments within the local area e.g. the delivery of a new district centre at Weston Mill, the Plymouth Life Centre and the housing regeneration project in North Prospect will seek to separately improve the health and well-being of the local population
- 18.9.6 The incorporated mitigation measures within the design of the proposed EfW CHP facility taken together with other developments in the local area can be reasonably considered to be capable of minimising the potential for adverse effects on the core protective factors for mental well-being. Overall the proposed scheme is highly unlikely to interfere with the successful implementation of any of the measures in Plymouth's Health, Social Care & Well-being Strategy that are intended to address priority health and well-being inequalities within Plymouth. Therefore the effect of the scheme (with incorporated mitigation) on health and well-being is considered to be negligible and any fears of potential health and well-being effects are unlikely to be objectively justified.

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