1 Introduction

This Appendix assesses the likely significant effects on air quality of the proposed development at the LLWR site as detailed in Volume I of the ES. The associated figure is also included in Volume I of the ES.

In particular, the assessment identifies the likely significant effects associated with the proposed development including:

- dust generation during construction and capping works;
- emissions generated by plant and equipment during construction and capping works;
- increases in emissions above baseline from road traffic associated with construction and capping works; and
- increases in emissions above baseline from rail freight associated with construction and capping works.

The implications for air quality will also be discussed briefly in respect to other operational aspects of the proposed development, including:

- disposal of waste in Vaults 9 to 11; and
- high stacking of containers in Vaults 8, 9 and all future vaults.

Only a brief discussion of the two aspects of the operational aspects of the proposed development listed above has been presented because current activities at the LLWR already comprise the movement of HHISO containerised LLW by train, low loader and forklift, delivery of cement and materials for the grouting facility and general site maintenance. The two operational aspects are not anticipated to notably change this situation and as such significant operational air quality effects are not expected from these two aspects of the proposed development.

The different phases of construction and capping are described further in Chapter 3 of Volume I of the ES The anticipated construction and capping programme is also discussed in Chapter 3 of Volume I of the ES. The programme indicates that that some phases of work will be undertaken up to the year 2051. Elements of air quality assessment will become uncertain over these extended timescales. For example government approved factors for describing vehicle emissions are available up to 2030 and factors for characterising changes in air quality over time are also only available up to 2030. Consequentially, the assessment has predominantly focused on the earlier years of activities. This approach is considered appropriate, as national ambient air quality is anticipated to improve over time and similar activities associated with this proposed development are planned during the earlier and later stages of the programme. Therefore, the assessment of air quality impacts on sensitive receptors around the site for the earliest years of activity should represent the worst case for the same sensitive receptors in later years.

The specific years of construction and capping that have been assessed are listed in Section 4. The rationale for selecting these years is also provided in Section 4.

2 Legislation

The principal air quality legislation within the United Kingdom is the Air Quality Standards Regulations 2010 [i], which came into force in June 2010 and brings together the Government's requirements to transpose the separate EU Daughter Directives into national legislation through a single consolidated statutory instrument.

In addition, the Environment Act 1995 [ii] requires the Government to produce a national Air Quality Strategy (AQS) containing standards, objectives and measures for improving ambient air quality and to keep the policies identified below under review. It also requires that Local Authorities undertake a tiered appraisal of air quality within their borough to establish compliance or non-compliance with the targets established in the AQS. Where the objectives are likely to be exceeded, the Authority must designate an Air Quality Management Area (AQMA) and establish an Action Plan, which outlines measures to achieve the objectives.

The AQS for England, Scotland, Wales and Northern Ireland [iii] provides the over-arching strategic framework for air quality management in the UK and contains national air quality standards and objectives established by the Government to protect human health. These objectives apply to outdoor locations where people are regularly present and do not apply to occupational, indoor, or in-vehicle exposure.

Table 2.1 Air Quality Strategy Objectives (µg/m^3)

Pollutant	Objective	Averaging period	Percentile	To be met by and maintained after
Nitrogen dioxide (NO_2)	200	1 hour	99.8th (18 exceedances/year)	31 Dec 2005
	40	Annual	Mean	31 Dec 2005
Particulate matter (PM_{10})	40	Annual	Mean	31 Dec 2004
	50	24 hour	90.4th (35 exceedances/year)	31 Dec 2004
Particulate matter ($PM_{2.5)}$	25	Annual	Mean	1 Jan 2015
Carbon monoxide (CO)	10,000	8-hour	100th	31 Dec 2003
Benzene	5	Annual	Mean	31 Dec 2010
1,3 butadiene	2.25	Annual	Mean	31 Dec 2003
Lead	0.25	Annual	Mean	31 Dec 2008
Poly aromatic hydrocarbons (PAH) (ngm^{-3})	0.25	Annual	Mean	31 Dec 2010
Sulphur dioxide (SO_2)	266	15 minute	99.9th (35 exceedances/year)	31 Dec 2005
	350	1 hour	99.7th (24 exceedances/year)	31 Dec 2004
	125	24 hour	99.2nd (3 exceedances/year)	31 Dec 2004

The air quality objectives applicable to Local Air Quality Management are set out in the Air Quality Standards Regulations 2010 [i]. Current assessment criteria applicable to the protection of human health and Local Air Quality Management based on the recent AQS and the 2010 Regulations are presented in Table 2.1. Concentrations are expressed in mass pollutant (micrograms) per cubic metre of air (µg/m3), unless otherwise stated.

In addition, a number of objectives have been developed for the protection of vegetation and ecosystems; these are shown in Table 2.2 below.

Table 2.2 Air Quality Strategy Objectives – Protection of Vegetation and Ecosystems

Pollutant	Objective	Averaging period	Percentile	To be met by
Oxides of Nitrogen (NO_x)	30 µg/m^3	Annual	Mean	31 Dec 2000
Sulphur dioxide (SO_2)	20 µg/m^3	Annual	Mean	31 Dec 2000
Ozone	18 mg/m^3	5 year average of summer 1 hour values		1 Jan 2010

The above legislation relates to concentrations of pollutants in ambient air with respect to the protection of human health or vegetation. There are no legislative standards or agreed guidelines for dust nuisance in the UK, for example due to dust deposition. Most issues of dust nuisance are covered through Statutory Nuisance legislation defined in the Environmental Protection Act, Part III, 1990, Section 79, Parts (d) and (e) which covers dust [iv]:

> *'d) Any dust, smell or effluvia arising on industrial, trade, or business premises and being prejudicial to health or a nuisance;*
>
> *e) Any accumulation or deposit which is prejudicial to health or a nuisance.'*

In the absence of legislative standards for deposited dust there are however a number of non-statutory guidelines that are available when measuring the effect of dust deposition. For example the Environment Agency (EA) has set a custom and practice limit of 200 mg/m^2/day [v], which is the threshold above which the EA considers there is the potential for justifiable nuisance complaints.

3 Planning Policy Context

3.1 National Planning Policy Framework

Air quality is considered in national planning policy. This sub-section identifies the key national policy guidance from these different policy areas.

The National Planning Policy Framework (NPPF) was published in March 2012 [vi]. Paragraph 109 of the NPPF states that: *"The planning system should contribute to and enhance the natural and local environment by: preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability…"*

Annex 2 of the NPPF defines 'Pollution' as: *"Anything that affects the quality of land, air, water or soils, which might lead to an adverse impact on human health, the natural environment or general amenity. Pollution can arise from a range of emissions, including smoke, fumes, gases, dust, steam, odour, noise and light"*.

The effect of the proposed development on the achievement of such policies and plans are matters that may be a material consideration by planning authorities, when making decisions for individual planning applications. Paragraph 124 of the NPPF states that: *"Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan."*

The different roles of a planning authority and a pollution control authority is addressed by the NPPF in paragraph 122:*"... local planning authorities should focus on whether the development itself is an acceptable use of the land, and the impact of the use, rather than the control of processes or emissions themselves where these are subject to approval under pollution control regimes. Local planning authorities should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities."*

3.2 Planning Practice Guidance

The Planning Practice Guidance (PPG) [vii], provides a summary of the air quality issues set out in the National Planning Policy Framework and goes on to note that the assessment should include the following information:

- the existing air quality in the study area (existing baseline);
- the future air quality without the development in place (future baseline); and
- the future air quality with the development in place (with mitigation).

The guidance then advises that the application should proceed to decision with appropriate planning conditions or planning obligation, if the development proposed (including mitigation) would not lead to an unacceptable risk from air pollution, prevent sustained compliance with EU limit values or fail to comply with the requirements of the Habitats Regulations.

The PPG (Paragraph: 023 Reference ID: 27-023-20140306) includes a specific 4 step assessment approach for dust emissions. This step by step approach is described in Section 4 Assessment Methodology of this appendix.

3.3 Regional Planning Policy

The Cumbria Minerals and Waste Development Framework [viii] includes: "Objective 8. That the overall quality of Cumbria's environment will be protected and, where practicable, enhanced by high standards of design and operation in new developments and high standards of restoration once developments have been completed." Within the plan objective 8 is implemented through two policies: Core Strategy Policy 3 Community Benefits and Core Strategy Policy 4 Environmental Assets.

3.4 Local Planning Policy

The Copeland Core Strategy and Development Management Plan (DPD) [ix] includes strategic development principles including: C Protect, enhance and restore the Borough's valued assets and in particular *'vi) Ensure development minimises air, ground and water pollution'*.

The DPD also includes Policy DM5 – Nuclear Sector Development at Sellafield and the LLWR at Drigg to work in partnership with the sites operators to minimise any adverse effects.

No supplementary air quality planning guidance has been identified for Copeland Borough Council.

4 Assessment Methodology

This Section identifies the study pollutants associated with the different potential emission sources associated with the proposed development. The Section also identifies the sensitive receptors that could potentially be affected by the emission sources, and describes the significance criteria used to determine the significance of effects on these receptors. The Section also describes the assessment methodology utilised for each potential emission source. Key study guidance is also outlined at the commencement of the assessment methodology section.

4.1 Study Guidance

The following guidance has been utilised in the assessment of air quality issues for the proposed development:

- Building Research Establishment (BRE). (2000). Effects of a Construction Site on Local PM10 levels [x].
- Department for Communities and Local Government (DCLG) (2014) Planning Practice Guidance: Minerals [xi].
- Department for Environment, Food and Rural Affairs (Defra) (2009) Local Air Quality Management Technical Guidance LAQM.TG(09) [xii].
- Environment Agency (2011) Horizontal Guidance H1- Annex F Air Emissions [xiii].
- Highways Agency (2007) Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1, HA207/07, Air Quality [xiv].
- Institute of Air Quality and Management (IAQM) (2014), Guidance on the Assessment of Dust from Demolition and Construction [xv].
- Environmental Protection UK and Institute of Air Quality and Management (IAQM) (2015) Land-use Planning and Development Control: Planning for Air Quality [xvi].

4.2 Study Scenarios

The construction and capping works are anticipated to proceed from 2016 and to be finalised in 2015. The following phases are described in Chapter 3 of the ES:

- Phase 1 – site preparation (2016 to 2020), including northern and eastern perimeter landform and profile filling of northern part of trenches;
- Phase 2 – cap Vault 8 and construct Vaults 9A and 10 (2019 to 2023);
- Phase 3 – cap Vault 9 and construct Vault 11 (2023 to 2030);
- Phase 4 – cap Vault 10 (2030 to 2032); and
- Phase 5 – cap Vault 11 (2045 to 2051).

Phases 1 and 2 include all the types of activities which will occur during the full construction programme including: site preparation works, earthworks, stockpiling and construction works. The on-site contractor's compound will also be in use during these phases. These phases are therefore representative of the types of effects anticipated around the site. Additionally, these works are in close proximity to surrounding sensitive receptors and will occur in the earliest years of the works before the further improvements in background air quality which are anticipated to occur over the duration of the development. As such Phases 1 and 2 are considered to represent the worst case for dust effects around the site and these phases have been the focus of the dust assessment.

Later years of construction, with larger areas of re-profiled trenches and vaults and also potentially larger stockpiles, have not been assessed as additional phases. This is because areas of re-profiled trenches and vaults will be progressively vegetated and similarly any large long term stockpiles will be vegetated or stabilised. Therefore, it has not been considered necessary to assess, larger potential source areas of dust, particularly when these sources have been considered in earlier years with higher likely baseline pollutant concentrations.

A scheme of works to covering the final decommissioning, removal and demolition of the PCM retrieval facilities and magazines is also due to be undertaken between 2018 and 2019. These works do not form part of the works which this

Environmental Statement supports. However, these works are considered as part of the cumulative assessment for this proposed development.

4.3 Potential Pollutants

The following paragraphs identify the relevant study species from the identified potential sources of pollutants including vehicle emissions from road vehicles and off-road plant, construction dust emissions, rail emissions and operational activities at the proposed development. The main study pollutants identified for the main emission sources in the construction and operational phases are also identified in Table 4.1. There are no point source emissions associated with the proposed development.

Table 4.1 Potential Pollutant Matrix

Activity	PM_{10}	$PM_{2.5}$	NO_2	SO_2	Dust
Construction					
Traffic	●	●	●		
Plant Equipment	●	●	●		
Rail Freight	●	●	●	●	
Works (e.g. earthmoving)	●				●
Operation					
Traffic	●	●	●		
Plant Equipment	●	●	●		
Rail Freight	●	●	●	●	

The key pollutants of concern with respect to construction activities are suspended dust (e.g. PM_{10} and in particular the coarser size fractions above $PM_{2.5}$) and accumulated dust (soiling/deposition). This is due to the movement of on-site plant equipment, movement of materials on-site and stockpiling of materials on-site.

Emissions of dust are considered to be the key pollutant of concern for the types of activity involved in the proposed development. For example the other study pollutants identified in Table 4.1 are not identified in the DCLG Planning Practice Guidance: Minerals [vii]. However, for completeness the other study pollutants are considered as described in the following paragraphs and sub-sections.

Traffic and plant vehicle exhaust emissions (e.g. from petrol and diesel combustion) comprise a complex mixture of organic and inorganic substances. Of these emissions, assessment criteria for the protection of human health exist for the following pollutants:

- fine particulate matter (PM_{10} and $PM_{2.5}$);
- nitrogen dioxide (NO_2);
- sulphur dioxide (SO_2);
- carbon monoxide (CO);
- benzene;
- 1,3-butadiene;
- lead; and
- Polycyclic Aromatic Hydrocarbons (PAHs)

These pollutants are currently regulated because of their known or suspected deleterious effects upon human health, and because historically, relatively high concentrations have been recorded within and downwind of urban centres.

Within this assessment of vehicular emissions, only fine particulate matter and NO_2 emissions have been considered. Lead is not included as it is no longer added to petrol fuels and emissions from vehicles are, therefore, not considered significant nationally. SO_2 emissions from vehicles are also considered to be insignificant since the introduction of low sulphur diesel and the negligible sulphur content of petrol fuels. The only AQMAs to have been designated within the UK as a result of exceedances of CO, benzene, PAH or 1,3-butadiene objectives was for benzene which was designated by Plymouth City Council at an urban location, predominantly due to emissions from a petrol station, therefore, no quantitative assessment of these pollutants is considered necessary.

In accordance with Defra LAQM.TG(09) [xii] SO_2 and NO_2 are considered to be the key pollutants of concern with respect to railway emissions. The potential for emissions from rail movements to and from the site will therefore be considered with respect to SO_2 and NO_2.

4.4 Health Effects

The study pollutants described in the preceding paragraphs have been selected based on the potential of the species to adversely affect human health or adversely affect vegetation and sensitive ecosystems. The known health effects of some of the key identified study species are briefly discussed below:

- Particulate matter – Health based assessment criteria focus on the fine 'PM_{10}' and '$PM_{2.5}$', size fractions. PM_{10} and $PM_{2.5}$ are defined as particulate matter with an aerodynamic diameter of less than 10 microns and 2.5 microns respectively. Emissions of particulates from construction activities and combustion processes are likely to contain a range of particulate sizes, including many larger than 10 microns in diameter. However for the purposes of a worst-case assessment and to enable comparison with national air quality objectives, all airborne particulate emissions have been assumed to constitute PM_{10}. Although the health effects of fine particulate matter are currently the subject of much research, the possible association between exposure to increased levels and respiratory and cardiovascular illness, and mortality has previously been acknowledged. Recent reviews by the World Health Organisation (WHO) and the Committee on the Medical Effects of Air Pollutants (COMEAP) have suggested exposure to $PM_{2.5}$ gives a stronger association with adverse health than the larger particulate fractions.
- Nitrogen dioxide (NO_2) and oxides of nitrogen (NO_x) – Formed as a by-product of high temperature combustion by the oxidation of nitrogen in the air and the fuel. NO_x on emission primarily consists of nitric oxide (NO), which is oxidised in the atmosphere to produce NO_2, as well as small quantities of NO_2 produced directly during combustion. For combustion sources, NO_x emissions are typically in the NO:NO_2 ratio of 9:1. NO_2 is the component of NO_x that is principally associated with health impacts, including effects on lung function and airway responsiveness, and potential increase in reactivity to natural allergens (Ref. 9.3).
- Sulphur dioxide (SO_2): Formed during the combustion process due to the oxidation of sulphur present in the fuel. The sulphur content of natural gas is typically 0.001%, compared to the sulphur content of coal of typically 1% or higher. SO_2 can cause constriction of the airways of the lung, particularly in people suffering from asthma and chronic lung disease.

4.5 Sensitive Receptors

A number of sensitive receptors have been identified within the vicinity of the proposed development and these are detailed in Table 4.2 and shown on Figure 11.1.

Guidance concerning receptor sensitivity (based on Ireland, 1992) [xvii] indicates that receptors are considered to have varying sensitivities to dust nuisance ranging between: high, medium and low for example:

- receptors considered to be high sensitivity include: hospitals and clinics, retirement homes, hi-tech industries, painting and furnishing and food processing;
- receptors of medium sensitivity include: schools, residential areas, food retailers, glasshouses and nurseries, horticultural land and offices; and
- low sensitivity receptors include: farms, light and heavy industry and outdoor storage areas.

There are no high sensitivity receptors around the site, but there are adjacent medium sensitivity receptors and low sensitivity receptors (e.g. R5). The assessment has predominantly focused upon these nearby receptors and upon one designated ecology site (i.e. R7). Therefore the assessment is protective of all other low sensitivity receptors (e.g. farmland) or medium sensitivity sites located further from the site.

Table 4.2 Identified Sensitive Receptors

Receptor Number	Receptor Name	Reason for Selection	Emission Type	Grid Reference		Distance to work areas (m)*
				X	Y	
R1	Summer View	Residential receptor close to the north of the site and the trenches	Plant emissions and dust generation.	305065	499940	50
R2	The Stubble	Residential receptor close to the north of the site and the trenches	Plant emissions and dust generation.	305611	499481	60
R3	Drigg Moorside	Residential receptor close to the north of the site and the trenches	Plant emissions and dust generation.	305615	499844	250
R4	Sandy Acre	Closest residential receptor to the south of the site	Plant emissions and dust generation.	305524	498742	280
R5	Coal Yard	Commercial Receptor to the west of the site	Plant emissions and dust generation.	304828	499839	15
R6	Meadowbridge	Closest residential receptor to contractor compound	Plant emissions.	306286	499061	280
R7	Drigg Coast	Designated SSSI and SAC to the south and west of the site	Plant emissions and dust generation.	304881	499499	0

Notes: * - includes distances from on-site haul routes and areas of work e.g. construction and earthworks. For residential receptors distances to closest façade.

4.6 Assessment of Dust Emissions Generated During Construction Works

This assessment is based upon the framework of minerals advice for dust in the PPG (Paragraph: 023 Reference ID: 27-023-20140306) which includes the following overall approach:

- identify residential properties and other sensitive uses within 1 km and whether PM_{10} concentrations are likely to exceed air quality objectives in the area;
- if there are residential properties and sensitive land uses within 1km and there is a risk of PM_{10} objectives being exceeded then an assessment of impacts and the likely effectiveness of mitigation is required to determine whether or not impact is significant;
- alternately if there are no sensitive receptors within 1km or where there are sensitive receptors but PM_{10} concentrations are not likely to exceed air quality objectives then no assessment is required and good practice mitigation measures should be identified; and
- where an assessment is undertaken this should identify good practice mitigation and PM_{10} monitoring measures.

In order to establish the risk of PM_{10} objectives being exceeded research undertaken by Building Research Establishment (BRE) has been referred to within the assessment. In 2000 the BRE [x] undertook six months of continuous PM_{10} sampling at three locations within 200 m of a demolition and construction site of 0.65 hectares. The assessment of potential impacts associated with construction and site clearance works is more uncertain than for point source emissions that can be more accurately characterised and modelled. Consequently it was considered that linking the impact assessment to a monitoring-based study rather than relying on dispersion modelling represents the most valid way to assess potential impacts from the proposed works.

The site studied in the BRE report was a former chemical works and required demolition of existing buildings, piling along some of the site boundary, excavation of soil to a depth of 1 m across the site (greater than 1 m in some areas), and the subsequent erection of new structures. The BRE study took boundary particulate measurements during a range of site clearance and construction activities and taking into account the wind direction. It is the only published study that monitored and assessed dust generation from diffuse sources such as earth works and construction operations. During working hours, in the 6-month monitoring period, 24-hour average PM_{10} concentrations within 1 m of the study site boundary increased by up to 11 $\mu g/m^3$ during demolition, 3 $\mu g/m^3$ during site preparation and 5 $\mu g/m^3$ during piling and earth working (including a period of piling at the site boundary). PM_{10} concentrations beyond around 150 m from the

construction site were indistinguishable from background levels. The site under study utilised 'best practice' dust mitigation measures and the site did not receive any complaints concerning dust effects, despite the presence of residential properties within 10 m of the site perimeter. The site in the BRE study utilised 'best practice' dust mitigation measures during construction works so that the measured impacts were after mitigation measures had been applied.

The findings of this BRE study, specifically the site preparation and earth works increases in concentration, have been directly applied to the proposed development combined with the ambient background levels of particulate matter for the area. Therefore it has been assumed that the same changes in PM_{10} 24-hour concentrations will occur at the boundary of the proposed development construction works. The assessment focuses upon effects against the 24-hour air quality objective because the majority of dust emissions are due to dust generating activities that will only take place during working hours (07:30 to 18:00 Monday to Friday and 08:00 to 13:00 on Saturdays with no workings on Sundays or Public / Bank Holidays).

Some dust emissions may also arise outside of working hours from areas of bare ground and stockpiles etc. However, this type of source is anticipated to be small and can be managed through temporary covers, barriers, stabilising long term stockpiles with vegetation or binding agents. Therefore, as the above method will likely over estimate PM_{10} contributions a significance of effect has not been assigned to changes in concentration against annual PM_{10} concentrations, but information on annual average PM_{10} total concentrations is also provided to give an indication of the risk that this objective may be exceeded by the works.

It is noted that the overall proposed development site is larger than that considered within the BRE study. However, working areas within construction sites at any one time will be smaller than the overall site. Additionally, the assessment has also considered what would be the effect on 24-hour PM_{10} concentrations if a number of activities were on-going concurrently in Phases 1a, 1b and 1c.

The coastal location of the Proposed Development may result in additional or stronger wind movements towards sensitive locations, in particular locations east of the site (e.g. The Stubble, a residential location). This could result in higher 24-hour averages in these locations further from the site boundary relative to those in the BRE study. In order to address this potential limitation dust generation predictions for these receptors were undertaken assuming these receptors were at the site boundary and not 30 to 50m from the boundary. The BRE study reports the worst case monitored impacts in any wind direction and these worst case results have been applied in this assessment; the actual wind direction is therefore immaterial to the assessment.

The adjusted BRE approach utilised in the ES is considered appropriate to provide potential changes in dust and total dust concentrations during construction works (e.g. earthworks). However, as discussed above, any construction assessment approach will have a higher degree of uncertainty than an operational assessment for roads or industrial point sources. This is because these sources have well defined consistent emissions, whilst construction activities are inherently variable, with activities undertaken in varying locations and at different levels of intensity.

Good practice mitigation and monitoring measures to be included in the proposed scheme are presented in Section 8. A Principal Contractor will be appointed by the Applicant to develop and implement a Construction Environmental Management Plan (CEMP) (see Chapter 19 in the ES), which will present a comprehensive list of mitigation measures, based on the approach outlined herein for agreement with the Council.

4.7 Assessment of Site Plant

Emissions to air during construction activities will be associated with on-site construction vehicles and plant.

In order to provide an indication of the likely effects of emissions from the plant equipment associated with the Core Scenarios a series of scenarios have been modelled using the atmospheric dispersion model ADMS. These scenarios can only provide an indication of likely pollutant concentrations. This is because compared to other more well defined emission sources such as Environment Agency regulated point and area sources, with set emission limits, the movement of plant on-site is inherently uncertain.

In these scenarios a 50m by 50m area of construction has been modelled as an area source in ADMS for a variety of plant configurations. A 50m by 50m area has been selected as it is considered to be a conservative area, as in reality it is likely that the plant equipment will be spread over a wider area and hence have a lower emission rate per square metre than that modelled. The configurations of plant modelled in the different scenarios are shown in Table 4.3. The emission rates have been obtained from the European Environment Agency's Air Pollutant Emissions Inventory Guidebook 2009 [xxi].

Table 4.3 Plant Equipment Emissions Area Sources

Core Scenario Year	Plant Equipment Included	NO_x emission rate (g/s)	PM_{10} emission rate (g/s)	Reason for Plant Selection
Phase 1a	Four Excavators Four Dumpers in an area at the north of the site	2.17	0.35	Worst case for receptors north of the site with equipment from perimeter landform construction.
Phase 1a	Four Excavators Four Dumpers in an area at the south of the site	2.17	0.35	Worst case for the Drigg Coast SAC south of the site with equipment from attenuation pond construction.
Phase 1b	Four Excavators Four Dumpers One Roller Two Bulldozers in an area in the north west of the site	3.03	0.45	This year has been modelled as this is the first year of earthworks on the trenches.
Phase 1c	Four Excavators Four Dumpers One Roller Two Bulldozers in an area in the north of the site, immediately south of the site boundary and south of The Stubble (R2).	3.03	0.45	First year of fill placement on the shoulders of the trenches. This approach assumes that both sets of works are undertaken in the same area, in reality there is only likely to be limited overlap in activities.

Note: No 2019 Core Scenario has been modelled for plant emissions as the closest human health receptors to the areas of construction are more than 200m from the works, which is too far to be significantly affected. Potential effects in 2019 for the Drigg Coast SAC are discussed in comparison to the worst case works undertaken adjacent to the SAC in 2013.

The two area sources described in Table 4.3 for Phase 1a have all been modelled as occurring simultaneously. This provides a cumulative assessment of the main emission sources in Phase 1a for the sensitive receptors.

The stockpile plant emissions described in Table 4.3 have also been included in the models run for Phases 1b and 1c to provide a cumulative assessment with the earthworks and capping activities during these years.

NO_2 and PM_{10} results for short term and long term averages have been obtained for each of the seven receptors identified in Table 4.2. In order to provide an assessment of $PM_{2.5}$, against the $PM_{2.5}$ annual average AQS objective it has been assumed that all of the PM_{10} is $PM_{2.5}$.

The modelling has been undertaken using a site specific meteorological dataset that combines wind speed, direction and temperature taken from the meteorological station located on-site with missing data such as cloud cover that has been obtained from the monitoring station at Blackpool Airport.

The area sources have been used with a time varying emission factor which allows emissions to be released only during working hours.

A surface roughness of 0.2 to represent open grassland has been used in the model to reflect the open agricultural character of the area.

No terrain files have been included in the modelling as there are no significant changes in topography which would be likely to affect model predictions.

A sensitivity analysis of would typically be undertaken for a dispersion modelling exercise for point sources and area sources. This testing would be undertaken to establish the sensitivity of model results to those inputs which could vary and affect model results (e.g. meteorological conditions etc.). In this instance a sensitivity test could be undertaken to characterise the potential variation in model outputs, typically around 20%, but sensitivity testing could not resolve the uncertainty inherent in the movement of plant equipment around the site. Therefore, as outlined above this modelling work is considered to be indicative only and should only really be used to highlight the potential risk of non-compliance

with AQS objectives. However, to assist the reader, with a coherent language to describe results, the magnitude of change and significance of change criteria outlined in Section 4.6 have been utilised to describe results.

4.8 Assessment of Road Traffic

The level of assessment for road traffic emissions has been established by comparison of anticipated construction and operational traffic flows against a series of traffic criteria which identify significant changes in traffic that have the potential to affect air quality with respect to PM_{10} and NO_2. Where potentially significant traffic changes are identified these are then modelled using either the DMRB air quality screening model or an advanced air quality dispersion model, as appropriate.

The DMRB guidance [xiv] xiv states that assessment of affected roads is only considered necessary where proposals would result in:

- 'An increase in daily traffic flows by 1,000 or more; or
- Daily Heavy Goods Vehicles (HGVs) flows will change by 200 or more; or
- Daily average speed will change by 10 km/hr or more; or
- Peak hour speed will change by 20 km/hr or more.'

The EPUK and IAQM (2015) Land-use Planning and Development Control: Planning for Air Quality [xvi] provides a list of traffic change criteria that indicate when further air quality assessment may be required for locations outside AQMAs:

- '1. Cause a significant change in Light Duty Vehicle (LDV) traffic flows on local roads with relevant receptors. (LDV = cars and small vans <3.5t gross vehicle weight) of 500 vehicles or more.
- 2. Cause a significant change in Heavy Duty Vehicle (HDV) flows on local roads with relevant receptors. (HDV = goods vehicles + buses >3.5t gross vehicle weight) of 100 vehicles or more.
- 3. Realign roads, i.e. changing the proximity of receptors to traffic lanes. Where the change is 5m or more and the road is within an AQMA.
- 4. Introduce a new junction or remove an existing junction near to relevant receptors. Applies to junctions that cause traffic to significantly change vehicle accelerate/decelerate, e.g. traffic lights, or roundabouts.

The results of the screening exercise to identify if there are any roads requiring further assessment are presented in Section 6.

4.9 Assessment of Rail Freight Emissions

The Defra LAQM.TG(09) guidance document [xii] provides guidance on the assessment of rail emission sources, including guidance relating to stationary or moving locomotives, identifying distances from sensitive receptors and timescales for idling etc. which may cause concern. Only if all the following criteria are met is further assessment required:

- are the locations where diesel trains may be regularly idling for 15 minutes or more?;
- is there relevant outdoor exposure within 15 meters?; and
- are there three or more occasions a day when there might be a locomotive stationary with its engine running for 15 minutes?

The assessment of rail freight emissions is presented in Section 6.

4.10 Significance Criteria

The PPG minerals approach for the consideration of dust does not include a set of significance criteria for PM_{10} effects, rather focusing on the likelihood of exceedances of PM_{10} air quality objectives.

However, to provide an indication of the significance of effects consistent with EIA requirements set of criteria have been used for short term PM_{10}.

The EPUK and IAQM (2015) Land-use Planning and Development Control: Planning for Air Quality [xvi] approach has been not been utilised as a significance approach for PM_{10} emissions from construction works is not included within this guidance.

A significance approach for short term PM_{10} based on changes in concentration is also not included in the IAQM (2014), Guidance on the Assessment of Dust from Demolition and Construction [xv.

In the absence of a set of short term PM_{10} magnitude of change and significance criteria the previous set of PM_{10} short term criteria from the EPUK [xviii] have been utilised (see Tables 4.4 and 4.5).

Table 4.4 Determination of Magnitude of Change (24-hour PM_{10})

Magnitude of change	Days PM_{10} >50μg/m3
Large	Increase/decrease >4 days
Medium	Increase/decrease 2-4 days
Small	Increase/decrease 1-2 days
Imperceptible	Increase/decrease <1day

Table 4.5 Significance of Effects (24-hour PM_{10})

Dust Deposition	Dust Deposition			
	Imperceptible	Small	Medium	Large
Increase with proposed development				
Above Objective/Limit Value With proposed development (>35 days)	Negligible	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With proposed development (32-35 days)	Negligible	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With proposed development (26-32 days)	Negligible	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With proposed development (<26 days)	Negligible	Negligible	Negligible	Slight Adverse
Decrease with proposed development				
Above Objective/Limit Value Without proposed development (>35 days)	Negligible	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value Without proposed development (32-35 days)	Negligible	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value Without proposed development (26-32 days)	Negligible	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value Without proposed development (<26 days)	Negligible	Negligible	Negligible	Slight Beneficial

There are two aspects of effect that should be taken into account when assessing the significance of the effect at individual receptors, these are:

- the magnitude of the change caused by the proposed development; and
- the absolute predicted environmental concentration in relation to the air quality objectives.

Particular significance should be given to a change that takes the predicted environmental concentration from below to above the national AQS objective or vice versa because of the importance ascribed to the objectives in assessing local air quality. The descriptors also allow for a very small change in concentration to be more significant when the absolute concentration is above the objective than for an absolute concentration below the objective.

Table 4.5 provides a mechanism for categorising magnitude of change and significance of impact at individual receptors. The descriptions of impact and significance from individual receptors should be utilised together to derive an overall judgement of significance of impact for the proposed development.

5 Baseline Conditions

Copeland Borough Council has been contacted to identify the most up to date air quality baseline information for the assessment. The Council provided the most recent Local Air Quality Management report for use in the assessment:, *2014 Air Quality Progress Report for Copeland Borough Council* [xix]. Dated October 2014. This report confirms that Copeland Borough Council has not identified any areas of poor air quality requiring declaration as AQMAs. The reports also indicate the there are no continuous air quality monitoring stations in the local authority area.

In the absence of continuous monitoring data the National Air Quality Archive Background Maps [xx] have been utilised to provide background PM_{10} and $PM_{2.5}$ concentrations. The closest National Grid Reference to the centre of the site for which data is available has been utilised (National Grid Reference: 305500, 499500). The 2015 PM_{10} annual average concentration listed for this National Grid Reference is 9.5 µg/m^3, which is approximately a quarter of the annual average air quality objective. The $PM_{2.5}$ concentration listed for this National Grid Reference is 6.5 µg/m^3, which is also approximately a quarter of the annual average air quality objective.

The Council operate a network of twenty four NO_2 passive diffusion tubes, although none at locations near Drigg. In the absence of tubes at the site, the other tubes in similar rural background locations operated by the Council have been reviewed to identify an appropriate background concentration of NO_2 for the assessment. The review identified four rural background sites as listed in Table 5.1. The highest concentration from the four locations is 6.3 µg/m^3 at Ennerdale School, and to provide a conservative estimate of background NO_2 this concentration has been utilised in our assessment. Compared to the annual average air quality objective this concentration is approximately a sixth of the objective.

Table 5.1 Rural Background Monitoring Locations in Copeland BC (2014)

Site ID	Site Name	Grid Reference	Data Capture for 2014 (%)	Bias Corrected NO_2 Concentrations µg/m^3
9	Playground, Ennerdale School	307004, 515863	100	6.3
16	Greendale Guesthouse, Wasdale	314419, 505569	100	3.8
19	Bootle Station, Bootle	309360, 489313	91	5.4
21	Calder Farm, Seascale	303800, 502681	100	6.2

As there is currently some uncertainty in the rates of improvement in air quality over time a conservative approach has been adopted for the assessment that does not assume any further improvements in pollutant concentrations.

Table 5.2 presents all the relevant background ambient air quality data for the required averaging periods. In accordance with the Environment Agency's H1 guidance (Annex f) [xxi], in the absence of actual measured short term background concentrations, these have been assumed to be twice the annual average concentration.

Table 5.2 Mean Background Pollutant Concentrations (µg/m^3)

Pollutant	Current Estimated Background (2015)	Objective	Averaging Period
NO_2	6.3	40	Annual mean
	12.6	200	1 hour, 99.8th percentile
PM_{10}	9.5	40	Annual mean
	19.0	50	Daily mean, 90.4th percentile
$PM_{2.5}$	6.5	25	Annual mean

No other background monitoring data was identified to characterise rates of dust deposition or soiling.

6 Likely Significant Effects

This section outlines the findings of the assessment undertaken following the approaches outlined in Section 4.

6.1 Assessment of Dust Generation during the Works

The assessment of dust generation (PM_{10}) from the works has been discussed for each of the worst case phases in the following sub-sections.

6.1.1 Phase 1 Site Preparation Works

The boundary of the coal yard is the closest identified receptor to the areas of potential dust generation in Phase 1. However, as a place of work, this receptor is not considered to be as sensitive as a residential receptor. Additionally, this receptor would not be assessed against the air quality objectives as places of works are covered by separate occupational health regulations. The closest residential receptor to the works north of the trenches is The Stubble (R2), at a distance of approximately 30 m from the site perimeter.

Applying the BRE figure for site preparation in Phase 1a results in a total short term PM_{10} concentration of 22 µg/m³ at the boundary (i.e. the background of 19.0 µg/m³ plus 3 µg/m³). The PM_{10} concentration at the facades of these receptors would be expected to be lower, due to reductions in concentration from additional dispersion with additional distance. Even when ignoring this additional distance from the site boundary, this anticipated change in concentration does not result in an exceedance of the 50 µg/m³ 24-hour AQS objective, and no additional days of exceedance are predicted. This is considered to be an imperceptible change in short term PM_{10} concentrations. Additionally, if this 24-hour concentration was applied to the annual average, which will over estimate annual effects, the total concentration would be 12.5 µg/m³, well below the 40 $\mu g/m^3$ objective.

Applying the BRE figure for earthworks in Phase 1b works results in a total short term PM_{10} concentration of 24 µg/m³ at the boundary (i.e. the background of 19.0 µg/m³ plus 5 µg/m³). The PM_{10} concentration at the facades of these receptors would be expected to be lower, due to reductions in concentration from additional dispersion with additional distance. Even when ignoring this additional distance from the site boundary, this anticipated change in concentration does not result in an exceedance of the 50 µg/m³ 24-hour AQS objective, and no additional days of exceedance are predicted. This is considered to be an imperceptible change in short term PM_{10} concentrations. Additionally, if this 24-hour concentration was applied to the annual average, which will over estimate annual effects, the total concentration would be 14.5 µg/m³, well below the 40 $\mu g/m^3$ objective.

In Phase 1c stockpile area A may be in operation. The application of the earthworks increase in short term PM_{10} concentrations results in the same predicted concentrations of 24 µg/m³ at the boundary for the short term and an annual concentration at the boundary of works of 14.5 µg/m³.

Should different phases of works overlap between Phases 1a, 1b and 1c it is still unlikely that either the short term or long term air quality objectives for PM_{10} would be exceeded. This is because a combination of site preparation contributions and earthworks in Phase 1b and stockpiling activities in Phase 1c results in a total concentration of PM_{10} of 32 µg/m³ (i.e. 13 µg/m³ total contribution plus 19 µg/m³ background) which is less than the 50 µg/m³ 24-hour AQS objective.

Meadowbridge (R6), the closest receptor to the Contractor's compound, is located over 250 m away. Utilising the findings of the BRE study, which identified no significant change in concentration at distances greater than 150 m from earthworks, no significant changes in concentration would be expected at Meadowbridge (R6).

6.1.2 Phase 2 Cap Vault 8 and Construction Vaults 9A and 10

Phase 2a is likely to have similar effects to those described for Phases 1b and 1c as similar activities will be taking place in the same North West Corner of the site.

Phase 2b has been considered as the earliest year of construction at the site and in particular the first year of construction works on a new vault (Vault 9A). A review of the receptors identified around the site has established that all receptors will be over 200 m from the area of construction of Vault 9A and additionally over 200 m from the area of construction for any vault. Utilising the findings of the BRE study, which identified no significant change in PM_{10} concentration at distances

greater than 150 m from a construction site, no significant changes in concentration would be expected at any identified receptor. This does not result in an exceedance of the 50 µg/m³ 24-hour AQS objective, and no additional days of exceedance are predicted.

6.1.3 Drigg Coast Dust Deposition

Smothering and toxic contamination of habitats is not considered to be a significant risk to the habitats within the Drigg Coast SAC/SSI. This is because a Principal Contractor will be appointed by LLW Repository Ltd to develop and implement a Construction Environmental Management Plan (CEMP), which will present a comprehensive list of mitigation measures to minimise dust generation at the site. Additionally, rainfall will wash away small amounts of deposited materials periodically. This effect is therefore considered to be of negligible significance.

In addition, the performance of any CEMP in minimising dust emissions will be monitored by a monitoring programme, as described in Section 8. This monitoring programme includes a Frisbee Gauge located within the Drigg SAC/SSSI.

6.1.4 Farmland

The assessment of dust has focused on residential locations (Façades and Gardens) and designated ecosystems closest to the site boundary, closest to the most potentially intensive works, as these are considered to be the most sensitive locations around the site. This approach is consistent with that of Ireland, 1992 [xvii] which notes that there are a range of different sensitivities for different land-uses to dust effects. As set out in Section 4.5, farms and industry are listed as low sensitivity locations and residential locations are listed as medium sensitivity locations.

In addition, farming and other commercial locations are also not strictly relevant locations for the application of ambient National Air Quality objectives. This is because places of works are covered by separate occupational health regulations whereas the air quality objectives are set for the protection of the general population including more sensitive groups such as children or the elderly, who are less likely to be in commercial locations for long periods.

Utilising the above approach no significant likely effects were predicted from dust generation at the most sensitive locations closest to the site boundaries. Therefore, whilst specific farming receptors were not listed in the assessment, by extension the effects on this less sensitive land use can also be considered to be insignificant.

Whilst farm land is not considered to be particularly sensitive to dust emissions, the CEMP developed for the site will include measures to minimise the egress of dust from construction in areas adjacent to farm land.

Additionally, the draft air quality monitoring programme (see Section 8 below) includes visual checks at locations adjacent to farmland to record and address any visible dust emissions.

6.1.5 Summary

In summary each year of works assessed has been predicted to not give rise to significant changes in PM_{10} concentrations due to dust generating activities at any sensitive receptor identified.

In comparison to the key PPG test of whether works are likely to result in exceedances of PM_{10} air quality objectives this is not considered to be likely. However, although significant effects are not anticipated suitable dust mitigation and monitoring measures are presented in Section 8.

6.2 Assessment of Emissions Generated by Plant Equipment during the Works

Indicative modelling of demolition/construction vehicle emissions has been undertaken (using ADMS (version 4.1)) as an area source emission, to represent the area under development, as described in Section 4. The modelling outcomes provide an indicative guide to the potential impacts from demolition/construction site plant, based on a set of assumptions and identified parameters.

The assessment of plant emissions from the works has been discussed for the sub-phases within Phase 1 in the following sub-sections. Changes in concentration and total concentrations are discussed for NO_2 and PM_{10} for short and long term averaging periods for completeness. Annual average $PM_{2.5}$ concentrations are also discussed, as this pollutant may be associated with plant exhaust emissions. However, as plant equipment emissions will only be released in working hours, the short term results are most applicable.

6.2.1 Phase 1a – Combined Activities

The results from the modelling of the two area sources in Phase 1a are shown in Tables 6.1, 6.2, 6.3 and 6.4. Tables 6.1 and 6.2 show the predicted results for short and long term NO_2. Tables 6.3 and 6.4 show the predicted results for short and long term PM_{10}. The magnitude of change and significance of change is also presented for each pollutant and receptor.

Table 6.1 Phase 1a Plant Predictions for NO_2 long term concentrations

Receptor Reference	Receptor Name	Change in Annual Average NO_2 (µg/m³)	Total Annual Average NO_2 (µg/m³)	Magnitude of Change	Significance of Change
R1	Summer View	<0.1	7.1	Imperceptible	Negligible
R2	**The Stubble**	0.3	7.4	Imperceptible	Negligible
R3	Drigg Moorside	<0.1	7.1	Imperceptible	Negligible
R4	Sandy Acre	<0.1	7.1	Imperceptible	Negligible
R5	Coal Yard	<0.1	7.1	Imperceptible	Negligible
R6	Meadowbridge	<0.1	7.1	Imperceptible	Negligible
R7	**Drigg Coast SAC**	0.4	7.5	Small	Negligible

Note: R7 Assigned a small magnitude of change as the change in concentration relative to the 30 µg/m³ Air Quality Strategy Objective for the Protection of Vegetation and Ecosystems, rather than the small/imperceptible magnitude it would have been assigned relative to the 40 µg/m³ Air Quality Strategy Objective. Bold indicates – worst case receptors. < - indicates less than.

The predictions indicate that either imperceptible or small changes are anticipated for each receptor for both short and long term changes in NO_2 concentration. A corresponding assessment of negligible significance has therefore been assigned to each human health receptor in Phase 1a with respect to NO_2 (R4 to R6). A negligible significance has also been assigned to the Drigg Coast (R7), the only ecological receptor, as the total predicted concentration is well below (less than 70%) of the annual average Air Quality Strategy Objective for the Protection of Vegetation and Ecosystems.

Table 6.2 Phase 1a Plant Predictions for NO_2 short term concentrations

Receptor Reference	Receptor Name	Change in short term NO_2 (µg/m³)	Total short term NO_2 Concentration (µg/m³)	Magnitude of Change	Significance of Change
R1	Summer View	0.2	14.4	Imperceptible	Negligible
R2	**The Stubble**	3.3	17.5	Small	Negligible
R3	Drigg Moorside	0.2	14.4	Imperceptible	Negligible
R4	Sandy Acre	<0.1	14.2	Imperceptible	Negligible
R5	Coal Yard	0.2	14.4	Imperceptible	Negligible
R6	Meadowbridge	0.2	14.4	Imperceptible	Negligible
R7	**Drigg Coast SAC**	9.2	23.4	Small	Negligible

Note: Bold indicates – worst case receptors. . < - indicates less than. For R7 Drigg Coast SAC there is no applicable short term AQS objective for the protection of ecosystems. Therefore, the Drigg Coast SAC short term results have been assessed against the 1-hour AQS objective for human health.

Table 6.3 Phase 1a Plant Predictions for PM_{10} long term concentrations

Receptor Reference	Receptor Name	Change in Annual Average PM_{10} (µg/m³)	Total Annual Average PM_{10} (µg/m³)	Magnitude of Change	Significance of Change
R1	Summer View	<0.1	8.4	Imperceptible	Negligible
R2	**The Stubble**	<0.1	8.4	Imperceptible	Negligible
R3	Drigg Moorside	<0.1	8.4	Imperceptible	Negligible
R4	Sandy Acre	<0.1	8.4	Imperceptible	Negligible
R5	Coal Yard	<0.1	8.4	Imperceptible	Negligible
R6	Meadowbridge	<0.1	8.4	Imperceptible	Negligible
R7	**Drigg Coast SAC**	0.1	8.5	Imperceptible	Negligible

Note: Bold indicates – worst case receptors. . < - indicates less than. For R7 Drigg Coast SAC there is no applicable annual AQS objective for the protection of ecosystems. Therefore the Drigg Coast SAC short term results have been assessed against the annual AQS objective for human health.

The predictions indicate that imperceptible changes are anticipated for each receptor for both short and long term changes in PM_{10} concentration. A corresponding assessment of negligible significance has therefore been assigned to each receptor in Phase 1c with respect to PM_{10}. Assuming all of the predicted PM_{10} is $PM_{2.5}$ and utilising the criteria developed in Section 4.6 the changes in annual average particulates in Phase 1a can also be similarly described as imperceptible and negligible.

Table 6.4 Phase 1a Plant Predictions for PM_{10} short term concentrations

Receptor Reference	Receptor Name	Change in short term PM_{10} (µg/m³)	Total short term PM_{10} Concentration (µg/m³)	Magnitude of Change	Significance of Change
R1	Summer View	<0.1	16.8	Imperceptible	Negligible
R2	**The Stubble**	0.1	16.9	Imperceptible	Negligible
R3	Drigg Moorside	<0.1	16.8	Imperceptible	Negligible
R4	Sandy Acre	<0.1	16.8	Imperceptible	Negligible
R5	Coal Yard	<0.1	16.8	Imperceptible	Negligible
R6	Meadowbridge	<0.1	16.8	Imperceptible	Negligible
R7	**Drigg Coast SAC**	0.2	17.0	Imperceptible	Negligible

Note: Bold indicates – worst case receptors. . < - indicates less than. For R7 Drigg Coast SAC there is no applicable short term AQS objective for the protection of ecosystems. Therefore the Drigg Coast SAC short term results have been assessed against the 24-hour AQS objective for human health.

6.2.2 Phase 1b – Combined Activities

The modelling results for Phase 1b are shown in Tables 6.5, 6.6, 6.7 and 6.8. Tables 6.5 and 6.6 show the predicted results for short and long term NO_2. Tables 6.7 and 6.8 show the predicted results for short and long term PM_{10}. The magnitude of change and significance of change is also presented for each pollutant and receptor.

Table 6.5 Phase 1b Plant Predictions for NO_2 long term concentrations

Receptor Reference	Receptor Name	Change in Annual Average NO_2 (µg/m³)	Total Annual Average NO_2 (µg/m³)	Magnitude of Change	Significance of Change
R1	**Summer View**	0.2	7.1	Imperceptible	Negligible
R2	**The Stubble**	0.1	7.0	Imperceptible	Negligible
R3	Drigg Moorside	<0.1	6.9	Imperceptible	Negligible
R4	Sandy Acre	<0.1	6.9	Imperceptible	Negligible
R5	Coal Yard	<0.1	6.9	Imperceptible	Negligible
R6	Meadowbridge	<0.1	6.9	Imperceptible	Negligible
R7	Drigg Coast SAC	<0.1	6.9	Imperceptible	Negligible

Note: R7 assigned an imperceptible magnitude of change as the change in concentration relative to the 30 µg/m³ Air Quality Strategy Objective for the Protection of Vegetation and Ecosystems. Bold indicates – worst case receptors. < - indicates less than.

Table 6.6 Phase 1b Plant Predictions for NO_2 short term concentrations

Receptor Reference	Receptor Name	Change in short term NO_2 (µg/m³)	Total short term NO_2 Concentration (µg/m³)	Magnitude of Change	Significance of Change
R1	**Summer View**	4.6	18.3	Small	Negligible
R2	**The Stubble**	1.6	15.3	Imperceptible	Negligible
R3	Drigg Moorside	0.2	13.9	Imperceptible	Negligible
R4	Sandy Acre	<0.1	13.7	Imperceptible	Negligible
R5	Coal Yard	0.5	14.2	Imperceptible	Negligible
R6	Meadowbridge	0.1	13.8	Imperceptible	Negligible
R7	Drigg Coast SAC	<0.1	13.7	Imperceptible	Negligible

Note: Bold indicates – worst case receptors. . < - indicates less than. For R7 Drigg Coast SAC there is no applicable short term AQS objective for the protection of ecosystems. Therefore the Drigg Coast SAC short term results have been assessed against the 1-hour AQS objective for human health.

The Phase 1b predictions indicate that either imperceptible or small changes are anticipated for each receptor for both short and long term changes in NO_2 concentration. A corresponding assessment of negligible significance has therefore been assigned to each receptor in Phase 1b with respect to NO_2.

Table 6.7 Phase 1b Plant Predictions for PM_{10} long term concentrations

Receptor Reference	Receptor Name	Change in Annual Average PM_{10} (µg/m³)	Total Annual Average PM_{10} (µg/m³)	Magnitude of Change	Significance of Change
R1	**Summer View**	<0.1	8.4	Imperceptible	Negligible
R2	**The Stubble**	<0.1	8.4	Imperceptible	Negligible
R3	Drigg Moorside	<0.1	8.4	Imperceptible	Negligible
R4	Sandy Acre	<0.1	8.4	Imperceptible	Negligible
R5	Coal Yard	<0.1	8.4	Imperceptible	Negligible
R6	Meadowbridge	<0.1	8.4	Imperceptible	Negligible
R7	Drigg Coast SAC	<0.1	8.4	Imperceptible	Negligible

Note: Bold indicates – worst case receptors. . < - indicates less than. For R7 Drigg Coast SAC there is no applicable annual AQS objective for the protection of ecosystems. Therefore the Drigg Coast SAC short term results have been assessed against the annual AQS objective for human health.

The Phase 1b predictions indicate that imperceptible changes are anticipated for each receptor for both short and long term changes in PM_{10} concentration. A corresponding assessment of negligible significance has therefore been assigned to each receptor in Phase 1b with respect to PM_{10}. Assuming all of the predicted PM_{10} is $PM_{2.5}$ and utilising the criteria developed in Section 4.6 the changes in annual average particulates in Phase 1b can also be similarly described as imperceptible and negligible.

Table 6.8 Phase 1b Plant Predictions for PM_{10} short term concentrations

Receptor Reference	Receptor Name	Change in short term PM_{10} (µg/m³)	Total short term PM_{10} Concentration (µg/m³)	Magnitude of Change	Significance of Change
R1	**Summer View**	0.1	16.9	Imperceptible	Negligible
R2	**The Stubble**	<0.1	16.8	Imperceptible	Negligible
R3	Drigg Moorside	<0.1	16.8	Imperceptible	Negligible
R4	Sandy Acre	<0.1	16.8	Imperceptible	Negligible
R5	Coal Yard	<0.1	16.8	Imperceptible	Negligible
R6	Meadowbridge	<0.1	16.8	Imperceptible	Negligible
R7	Drigg Coast SAC	<0.1	16.8	Imperceptible	Negligible

Note: For R7 Drigg Coast SAC there is no applicable short term AQS objective for the protection of ecosystems. Therefore the Drigg Coast SAC short term results have been assessed against the 24-hour AQS objective for human health.

6.2.3 Phase 1c – Combined Activities

The modelling results for Phase 1c are shown in Tables 6.9, 6.10, 6.11 and 6.12. Tables 6.9 and 6.10 show the predicted results for short and long term NO_2. Tables 6.11 and 6.12 show the predicted results for short and long term PM_{10}. The magnitude of change and significance of change is also presented for each pollutant and receptor.

Table 6.9 Phase 1c Plant Predictions for NO_2 long term concentrations

Receptor Reference	Receptor Name	Change in Annual Average NO_2 (µg/m³)	Total Annual Average NO_2 (µg/m³)	Magnitude of Change	Significance of Change
R1	Summer View	<0.1	6.7	Imperceptible	Negligible
R2	**The Stubble**	0.3	7.0	Imperceptible	Negligible
R3	Drigg Moorside	<0.1	6.7	Imperceptible	Negligible
R4	Sandy Acre	<0.1	6.7	Imperceptible	Negligible
R5	Coal Yard	<0.1	6.7	Imperceptible	Negligible
R6	Meadowbridge	<0.1	6.7	Imperceptible	Negligible
R7	Drigg Coast SAC	<0.1	6.7	Imperceptible	Negligible

Note: R7 assigned an imperceptible magnitude of change as the change in concentration relative to the 30 µg/m³ Air Quality Strategy Objective for the Protection of Vegetation and Ecosystems. Bold indicates – worst case receptors. < - indicates less than.

Table 6.10 Phase 1c Plant Predictions for NO_2 short term concentrations

Receptor Reference	Receptor Name	Change in short term NO_2 (µg/m³)	Total short term NO_2 Concentration (µg/m³)	Magnitude of Change	Significance of Change
R1	Summer View	0.2	13.6	Imperceptible	Negligible
R2	**The Stubble**	9.0	22.4	Small	Negligible
R3	Drigg Moorside	0.7	14.1	Imperceptible	Negligible
R4	Sandy Acre	<0.1	13.4	Imperceptible	Negligible
R5	Coal Yard	0.1	13.5	Imperceptible	Negligible
R6	Meadowbridge	0.3	13.7	Imperceptible	Negligible
R7	Drigg Coast	0.1	13.5	Imperceptible	Negligible

Note: Bold indicates – worst case receptors. . < - indicates less than. For R7 Drigg Coast SAC there is no applicable short term AQS objective for the protection of ecosystems. Therefore the Drigg Coast SAC short term results have been assessed against the 1-hour AQS objective for human health.

The Phase 1c predictions indicate that either imperceptible or small changes are anticipated for each receptor for both short and long term changes in NO_2 concentration. A corresponding assessment of negligible significance has therefore been assigned to each receptor in Phase 1c with respect to NO_2.

Table 6.11 Phase 1c Plant Predictions for PM_{10} long term concentrations

Receptor Reference	Receptor Name	Change in Annual Average PM_{10} ($\mu g/m^3$)	Total Annual Average PM_{10} ($\mu g/m^3$)	Magnitude of Change	Significance of Change
R1	Summer View	<0.1	8.3	Imperceptible	Negligible
R2	**The Stubble**	0.1	8.4	Imperceptible	Negligible
R3	Drigg Moorside	<0.1	8.3	Imperceptible	Negligible
R4	Sandy Acre	<0.1	8.3	Imperceptible	Negligible
R5	Coal Yard	<0.1	8.3	Imperceptible	Negligible
R6	Meadowbridge	<0.1	8.3	Imperceptible	Negligible
R7	Drigg Coast SAC	<0.1	8.3	Imperceptible	Negligible

Note: Bold indicates – worst case receptors. . < - indicates less than. For R7 Drigg Coast SAC there is no applicable annual AQS objective for the protection of ecosystems. Therefore the Drigg Coast SAC short results have been assessed against the annual AQS objective for human health.

The Phase 1c predictions indicate that imperceptible changes are anticipated for each receptor for both short and long term changes in PM_{10} concentration. A corresponding assessment of negligible significance has therefore been assigned to each receptor in Phase 1c with respect to PM_{10}. Assuming all of the predicted PM_{10} is $PM_{2.5}$ and utilising the criteria developed in Section 4.6 the changes in annual average particulates in Phase 1c can also be similarly described as imperceptible and negligible.

Table 6.12 Phase 1c Plant Predictions for PM_{10} short term concentrations

Receptor Reference	Receptor Name	Change in short term PM_{10} ($\mu g/m^3$)	Total short term PM_{10} Concentration ($\mu g/m^3$)	Magnitude of Change	Significance of Change
R1	Summer View	<0.1	16.6	Imperceptible	Negligible
R2	**The Stubble**	0.2	16.8	Imperceptible	Negligible
R3	Drigg Moorside	<0.1	16.6	Imperceptible	Negligible
R4	Sandy Acre	<0.1	16.6	Imperceptible	Negligible
R5	Coal Yard	<0.1	16.6	Imperceptible	Negligible
R6	Meadowbridge	<0.1	16.6	Imperceptible	Negligible
R7	Drigg Coast SAC	<0.1	16.6	Imperceptible	Negligible

Note: For R7 Drigg Coast SAC there is no applicable short term AQS objective for the protection of ecosystems. Therefore the Drigg Coast Short results have been assessed against the 24-hour AQS objective for human health.

Other years of capping works on the Trenches (e.g. Phases 2 and 3) are likely to have lesser impacts than those described for Phase 1c. This is because the works in Phase 1c on the trench shoulders are closer to receptors than the works which will be undertaken on the top of the trenches. Additionally, the assessment above has considered the potential effects of capping in combination with other works and so additional plant emissions have been considered. Finally, the assessment of Phase 1c will provide a worst case assessment as it is assumed that air quality will improve year to year.

6.2.4 Construction of Vault 9A

Consistent with the assessment of construction dust associated with the construction of Vault 9A no human health receptors are within 200m. Therefore, no significant changes in concentration are anticipated to be associated with plant emissions from these works with respect to human health. This is because vehicle emissions are typically not distinguishable from background pollutant concentrations at distances larger than 200m xiv. In comparison to the significance criteria (Section 4.6) this is considered to be an imperceptible magnitude of change of negligible significance.

6.2.5 Summary

Emissions to air during construction activities will be associated with on-site construction vehicles and plant. An assessment of these emissions was prepared using an estimate of plant emissions and indicative detailed modelling techniques. This indicated that very low changes in pollutant concentration were expected around the site and no significant effects were anticipated. The highest change in annual average NO_2 and PM_{10} concentrations predicted were 0.4 µg/m^3 and 0.1 µg/m^3 respectively. The highest changes in short term contributions of NO_2 and PM_{10} were 9.2 µg/m^3 and 0.2 µg/m^3. In summary, each year of works assessed has been predicted to not have significant changes in $PM_{10,}$ $PM_{2.5}$ or NO_2 concentrations due to plant equipment emissions at any sensitive receptor identified. In comparison to the significance criteria (Section 4.6), the changes in concentration have been considered to be of a small or imperceptible magnitude, with a negligible significance.

Furthermore, considering a worst case where an increase in the concentration of 24-hour PM_{10} arising from plant emissions is added to the change in PM_{10} 24-hour concentration arising from dust generating activities (Section 6.1), there is no change in the significance of effects previously identified. This is because the magnitude of change from the plant emissions is negligible for each receptor, with a maximum increase of 0.2 µg/m³.

Using the latest Environmental Protection UK (EPUK) and Institute of Air Quality and Management (IAQM) (2015) Land-use Planning and Development Control: Planning for Air Quality [xvi] a moderate effect (i.e. an effect which may be considered significant) would require a change in annual average concentrations of 4 µg/m^3. This would require an increase in concentration of 3.6 µg/m^3 (i.e. nine times higher) and 3.9 µg/m^3 (i.e. thirty nine times higher) for NO_2 and PM_{10} respectively which is very unlikely.

6.3 Emissions from Road Traffic Associated with the Works

The existing traffic data on local roads is provided in Appendix F. The traffic changes presented in Appendix F are based on various worst case assumptions. For example it has been assumed that all workers use a vehicle to reach site and therefore there will be no car sharing. It has also been assumed that deliveries for the different elements of each Phase, for example cut off wall deliveries and capping deliveries are required concurrently. This is not anticipated to be the case. The traffic increases are below the level of change requiring further assessment against both DMRB and EPUK criteria listed in Section 4. It is therefore considered that the changes in traffic associated with the works will result in imperceptible changes in NO_2 and PM_{10} and hence have a negligible significance in all years.

6.4 Assessment of Emissions from Rail Freight Associated with the Works

Currently up to one delivery (two movements) is made to the site each day to import materials and it is proposed that two additional train movements per day are required for the proposed development.

There are no significant additional emissions of NO_2, SO_2 or particulates which require further assessment based on the Defra LAQM.TG(09) criteria based on the above information. This is because whilst there are now up to four rail movements in total anticipated per day there is no relevant exposure to the railhead within 15 m. Therefore, negligible effects are anticipated to be associated with rail freight emissions.

6.5 Supplementary Assessments

The air quality implications of disposal of waste in Vaults 9 to 11 and commencing higher stacking (up to 9 high) in Vaults 8, 9, 10 and 11 are discussed in the two following sub-sections.

6.5.1 Disposal of waste in Vaults 9 to 11

The disposal of waste in Vaults 9 to 11 will involve the same types and numbers of plant equipment as currently utilised for the existing operations at the site. Therefore, no significant changes in emissions of NO_2 or PM_{10} are anticipated. Additionally, no significant changes exceeding the DMRB and EPUK criteria for operational traffic are anticipated. Consequentially, an imperceptible change in concentrations at all sensitive receptors is expected for NO_2 and PM_{10} with a negligible significance.

6.5.2 Higher stacking in Vaults 8, 9, 10 and 11

The disposal of waste in Vaults 8, 9, 10 and 11 with higher stacking will involve the same types and numbers of plant equipment as currently utilised for the existing operations at the site. Additionally, no significant changes exceeding the DMRB and EPUK criteria for operational traffic are anticipated. Therefore, no significant changes in emissions of NO_2 or

PM_{10} are anticipated. Consequentially, an imperceptible change in concentrations at all sensitive receptors is expected for NO_2 and PM_{10} with a negligible significance.

7 Drigg Coast SAC/SSSI – Additional Assessment for Habitats Risk Assessment

7.1 Air Quality Standards Assessment

An assessment of nitrogen dioxide from mobile site plant has been undertaken for the Drigg Coast Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI). These designations were represented by Receptor R7 and are discussed in Section 6.2. PM_{10} impacts were not considered for ecosystems as there are no objectives for the protection of ecosystems for PM_{10}.

The results of the assessment with respect to R7 are discussed in Section 6.2. Results were discussed in relation to the Air Quality Strategy Objective for the Protection of Vegetation and Ecosystems. The results of the predictions showed a maximum increase in NO_2 concentrations of 0.4 µg/m^3 in Phase 1a, falling to less than 0.1 µg/m³ in later years (See Table 7.1). The reduction in NO_2 contributions between years reflects the changing pattern of works on the site relative to the location of the SAC/SSSI.

Table 7.1 Phase 1 Plant Predictions for NO_2 long term concentrations

Receptor Reference	Receptor Name	Change in Annual Average NO_2 (µg/m³)	Total Annual Average NO_2 (µg/m³)	Magnitude of Change	Significance of Change
Phase 1a					
R7	Drigg Coast SAC	0.4	7.5	Small	Negligible
Phase 1b					
R7	Drigg Coast SAC	<0.1	6.9	Imperceptible	Negligible
Phase 1c					
R7	Drigg Coast SAC	<0.1	6.7	Imperceptible	Negligible

Note: R7 Assigned a small magnitude of change as the change in concentration relative to the 30 µg/m³ Air Quality Strategy Objective for the Protection of Vegetation and Ecosystems, rather than the small/imperceptible magnitude it would have been assigned relative to the 40 µg/m³ Air Quality Strategy Objective in Phase 1a. < - indicates less than. PM_{10} not considered for ecosystems as there are no objectives for the protection of ecosystems for PM_{10}. Oxides of sulphur are not considered as this is not a key pollutant of concern for the development.

Table 7.1 also shows that the total concentration of NO_2 (background plus contribution from the development) is less than 70% of the Air Quality Strategy Objective for the Protection of Vegetation and Ecosystems. This includes appropriate background contributions of NO_2 from other developments and activities in the area. These total NO_2 concentrations are less than the total concentration at which significant impacts may be expected**Error! Bookmark not defined.**.

7.2 Smothering and Toxic Contamination

Smothering and toxic contamination of habitats is not considered to be a significant risk to the habitats within the Drigg Coast SAC/SSSI. This is because a Principal Contractor will be appointed by LLW Repository Ltd to develop and implement a Construction Environmental Management Plan (CEMP), which will present a comprehensive list of mitigation measures to minimise dust generation at the site. Additionally, rainfall will wash away small amounts of deposited materials which may be deposited periodically.

In addition, the performance of any CEMP in minimising dust emissions will be monitored by a monitoring programme, (see Section 8). This monitoring programme includes a Frisbee Gauge located within the Drigg Coast SAC/SSSI. It is proposed that the performance of mitigation measures at this location would be managed against the Environment Agency [v] 200 mg/day/m^2 custom and practice limit. In any instances where this threshold was exceeded mitigation measures would be reviewed and improved where necessary to protect the Drigg Coast SAC/SSSI.

7.3 Nutrient Enrichment

The data presented in Table 7.1 has also been utilised in an assessment of nutrient enrichment. This has been undertaken by applying a deposition velocity of 0.1 m/s [xiv] to the NO_2 concentrations presented in Table 7.1 to calculate nitrogen deposition rates. These deposition rates have then been compared to the critical loads for nitrogen available for the Drigg Coast SAC[1].

A review of the habitats closest to the Proposed Development has identified that the most sensitive habitat type to nitrogen deposition is '*Fixed dunes with herbaceous vegetation (grey dunes)*'. This habitat has a critical load range of 8-10 kg nitrogen per hectare per year (N/ha/yr).

However, the APIS site indicates that the Drigg Coast SAC site is already subject to a nitrogen deposition rate of 12.74 kg/N/ha/yr, which is 4.74 kg/N/yr higher than the lowest critical load.

Relative to the current rate of deposition the maximum increase in nitrogen deposition predicted with the Proposed Development represents an increase of only 0.3%.

Comparing the increase in nitrogen deposition from the Proposed Development with the lowest critical load shows an increase of at worst 0.5% (See Table 7.2). This is less than the 1% above which significant effects [xiii] may occur and as such this is considered to be an increase of negligible significance.

Table 7.2 Phase 1 Plant Predictions for Nitrogen Deposition

Receptor Reference	Receptor Name	Change in nitrogen deposition rate (kg/N/ha/yr)	Percentage change in nitrogen deposition relative to lowest critical load	Magnitude of Change	Significance of Change
Phase 1a					
R7	Drigg Coast SAC	0.04	0.5	Imperceptible	Negligible
Phase 1b					
R7	Drigg Coast SAC	0.01	0.13	Imperceptible	Negligible
Phase 1c					
R7	Drigg Coast SAC	0.01	0.13	Imperceptible	Negligible

Note: lowest critical load 8 N/ha/yr.

The conclusion that the above changes in nitrogen are negligible is supported by the most recent published Common Standards Monitoring condition assessment for the Drigg Coast designated site by Natural England[2]. This condition assessment includes an assessment of the area adjacent to the Proposed Development boundary known as 'Compartment 21'.

The condition assessment process assesses a range of attributes, including vegetation structure and composition targets, all of which must pass for a compartment to be determined to be in favourable condition.

The most recent condition assessment published on the Natural England website in 2007 indicates that Compartment 21 is in favourable condition despite receiving nitrogen inputs at levels in exceedance of recommended precautionary critical loads, by 4.74 kg/N/ha/yr for the lowest critical load and 2.74 kg/N/ha/yr for the upper critical load. In this context a maximum change of 0.04 kg/N/ha/yr resulting from the Proposed Development is unlikely to significantly affect the condition of the habitat.

[1] http://www.apisdev.ceh.ac.uk/srcl
[2] (http://www.sssi.naturalengland.org.uk/Special/sssi/reportAction.cfm?report=sdrt13&category=S&reference=1000077)

7.4 Acidification

Increases in acidity from increased contributions of NO_2 have also been considered. In this assessment the values of nitrogen deposition (kg/N/ha/yr) have been used to derive kiloequivalents/ha/yr (keq/ha/yr), which are the units in which acidity critical loads are described. The conversion has been undertaken using the Air Pollution Information System unit conversion tool[3].

A review of the habitats closest to the Proposed Development has identified that the most sensitive habitat type to changes in acidity is '*Fixed dunes with herbaceous vegetation (grey dunes)*'. This habitat has two minimum nitrogen related acidity critical loads (MinCLminN) listed of 0.223 and 0.438 keq/ha/yr.

However, converting the APIS existing rate of nitrogen deposition into keq suggests that the Drigg Coast SAC site is already subject to a rate of nitrogen related acid deposition of 0.910 keq/ha/yr, which is between 0.687 and 0.472 keq/ha/yr higher than the lowest critical loads.

Relative to the current rate of deposition, the maximum predicted increase in nitrogen related acid deposition from the Proposed Development represents an increase of only 0.3%.

Comparing the increase in acidity with the Proposed Development with the lowest critical loads shows a maximum increase of between 0.7 and 1.4 % (See Table 7.3). This range is around the 1% increase above which significant effects may occur and as such this is considered to be an increase of negligible significance.

Table 7.3 Phase 1 Plant Predictions for Acidification

Receptor Reference	Receptor Name	Change in acidification (keq/ha/yr)	Percentage change in acidification relative to lowest critical loads	Magnitude of Change	Significance of Change
Phase 1a					
R7	Drigg Coast SAC	0.003	0.68 to 1.35	Imperceptible	Negligible
Phase 1b					
R7	Drigg Coast SAC	0.001	0.23 to 0.45	Imperceptible	Negligible
Phase 1c					
R7	Drigg Coast SAC	0.001	0.23 to 0.45	Imperceptible	Negligible

Note: Two minimum critical loads (MinCLminN) of 0.223 and 0.438 keq/ha/yr presented on APIS Site.
As described in the nutrient enrichment section, the conclusion that the changes predicted in acidity are negligible is supported by the Natural England Condition assessment for the Drigg Coast designated site[2].

The most recent condition assessment published on the Natural England website in 2007 indicates that Compartment 21 is in favourable condition despite receiving rates of acid deposition at levels in exceedance of recommended precautionary critical loads, by 0.687 keq/ha/yr for the lowest critical load. In this context a maximum change of 0.003 keq/ha/yr resulting from the Proposed Development is unlikely to significantly affect the condition of the habitat.

[3]http://www.apis.ac.uk/cgi_bin/unitconversion_result.pl?keqkg=keq&pollutant2=Nitrogen&value2=0.04&Submit=Calculate

8 Mitigation and Monitoring Measures

This section presents the mitigation and monitoring measures appropriate to minimise the effect on air quality from either construction or operational activities.

A Principal Contractor will be appointed by the Applicant to develop and implement a Construction Environmental Management Plan (CEMP), which will present a comprehensive list of mitigation measures, based on the approach outlined herein for agreement with the Council.

8.1 Plant Equipment Mitigation Measures

Despite the negligible predicted effect from construction and capping activities, construction vehicle emissions would be mitigated through:

- no vehicles or plant will be left idling unnecessarily;
- non-road mobile machinery (vehicles and plant) will be well maintained. Should any emissions of dark smoke occur (except during start up) then the relevant machinery will be stopped immediately and any problem rectified before being used again;
- engines and exhaust systems will be regularly serviced according to manufacturer's recommendations and maintained to meet statutory limits/opacity tests;
- plant will be located away from the boundaries close to residential areas or designated sensitive ecosystem sites; and
- use of diesel or petrol powered generators will be avoided by using mains electricity or battery powered equipment where possible.

8.2 Dust Mitigation Measures

In accordance with best practice, construction dust will be controlled through the application of a series of measures, including (where appropriate):

- regular inspection and, where necessary, wet suppression of material/soil stockpiles (including wind shielding, storage away from site boundaries);
- appropriate orientation of material stockpiles and minimising their height, to minimise wind dispersion;
- stabilisation or vegetation of long term stockpiles;
- provision of wheel washing and wet suppression during loading of wagons/vehicles;
- covering vehicles carrying dry spoil and other wastes;
- shielding of dust-generating construction activities with temporary barriers (e.g. around stockpiles and other dusty activities);
- provision of suitable site hoarding as physical control measure to minimise dust egress;
- restricting vehicle speeds on access roads and other unsurfaced areas of the site to 10 mph;
- inspection of unsurfaced haulage routes, and wet suppression as necessary, during prolonged dry periods;
- no waste materials will be burnt on-site;
- soil stripping is not to be undertaken during periods of high wind speeds of 8 m/s or more, which a 5 on the Beaufort Scale; and
- water suppression techniques were required to dampen down dusty activities.

The barriers and hoardings could be used to control a variety of potentially dusty activities including: stockpiling, soil stripping and earthmoving operations should measures such as water suppression be insufficient. Barriers and hoardings are utilised as a physical control measure for dust at source and in perimeter locations. The effective use of barriers is recommended in a variety of documents including: The London Best Practice Guidance Document [xxv], The Building Research Establishment Control of dust from construction and demolition activities [xxii] and the PPG [xi].

The size and type of solid barriers will vary between sites and will be dependent upon the source being screened. Similarly the location of barriers would be dependent upon the location of the sources on-site which require screening e.g. stockpile locations. These types of barriers will effective in managing dust when used in combination with a range of other mitigation measures e.g. water suppression.

A Principal Contractor will be appointed by LLW Repository Ltd to develop and implement a Construction Environmental Management Plan (CEMP), which will present a comprehensive list of mitigation measures for agreement with the Planning Authority (WPA). This will include the details of how barriers and hoarding will be used, located, moved, barrier materials and how long these would be required.

8.3 Air Quality Monitoring

In order to confirm the effectiveness of dust mitigation monitoring is proposed during the construction works. This section discusses the techniques, proposed thresholds for assessing the effectiveness of mitigation, the investigation approach where exceedances are identified and the reporting of monitoring etc. to the Council.

8.3.1 Monitoring Locations

Four air quality monitoring locations are proposed and their corresponding distances from the proposed development area are:

- M1 – Summer View, 50 m;
- M2 – The Stubble, 60 m; and
- M4 – Sandy Acre, 400 m
- M6 – Drigg Coast, 0 m.

These monitoring locations are illustrated on Figure 11.1 (as Receptors R1, R2, R4 and R6 respectively).

These receptors represent the worst case sensitive receptors around the site. Should access to these locations not be possible, alternative locations shall be chosen, and the reasons for assuming them to be representative, reported. For example if monitors cannot be located at properties or there is no safe off-site location for equipment then monitoring will be undertaken at site boundary locations. Locating monitors at site boundaries will tend to overestimate pollutant concentrations or rates of deposition, as monitors are closer to the potential sources of emissions.

8.3.2 Air Quality Monitoring Techniques

Three types of air quality monitoring are proposed for the construction works associated with the proposed development. These include: ambient sampling for suspended particulate matter, sampling for deposited dust and also visual observations.

A meteorology station is already located on-site and data from this site will be utilised in reporting and analysing monitoring data.

Ambient Suspended Particulate Sampling

Ambient suspended particulate sampling is proposed as properties such as Summer View (R1) are within close proximity to areas of potential dust generation. Due to the close proximity of works to this location it is proposed that Summer View is installed with a suspended dust monitor. However, if during works, other residential locations are closer to dust generating activities e.g. The Stubble (R2), monitoring should be relocated to the more sensitive location.

The monitor proposed to measure ambient suspended particulates is an Osiris monitor. Osiris monitors are small portable or semi-permanent monitors, which can be powered by solar cell, battery or mains electricity. The monitors can also be easily relocated and can be fixed to a variety of supports and monitors can be located in unsecured locations. Osiris monitors utilise a light scatter technique to measure TSP (Total Suspended Particulates), PM_{10}, $PM_{2.5}$ and PM_1 (particulate matter with an aerodynamic diameter of less than 1 micron). The Osiris monitors provided an average reading every fifteen minutes. Threshold alarms can also be set above which a text message can be sent to site managers etc. The Osiris monitor has achieved the Environment Agency's MCERTS certification [xxiii] (Monitoring Certification proposed development).

All of the above characteristics including: simultaneous analysis of different size fractions, averaging over short timescales, power source flexibility, ease of relocation, small monitor footprint and ability to issue text message alerts makes this monitor suitable for use in construction environments. This is why light scatter techniques, including Osiris, are

used by local authorities, construction companies and academic institutions in monitoring campaigns around construction sites.

The only limitation of the Osiris measurement technique is that it is not a reference equivalent technique and so PM_{10} data cannot be strictly used for EU compliance purposes. In particular the heated inlet, which draws in air for sampling, operates at 60^{o}C to minimise interferences from water vapour, and this will likely destroy some volatile particulate components. This potentially could lead the Osiris monitor to under-read total PM_{10} concentrations relative to reference techniques e.g. TEOM-FDMS.

Reference techniques (e.g. Tampered Element Oscillating Micro-Balances (TEOMs)) are not recommended for routine construction monitoring as these monitors require fixed concrete bases, or a large trailer enclosure, mains electricity, only focus on one particle size fraction, cannot be moved quickly and do not support text threshold monitoring. Breakdowns may also require specialist parts, sometimes from overseas locations and this can result in significant monitor downtime.

However, reference techniques could still be utilised in the event that Osiris monitors suggest a potential air quality compliance issue at a particular location, providing the above requirements can be safely achieved. For example, a reference technique could be utilised if Osiris monitoring suggested that the 35 24-hour AQS objective or Annual Average AQS objective may be breached in a year.

One year of baseline data will be collected in advance of works to provide a range of particulate data to describe different meteorological conditions. During construction the Osiris monitors will operate continuously. The Osiris units will be serviced annually.

Dust Deposition

Dust deposition sampling is proposed to provide an indication of dust which could cause a nuisance at sensitive residential locations (e.g. Sandy Acre (R4)) and could also impact on ecosystems (e.g. Drigg Coastline). It is proposed that dust deposition is sampled using Frisbee gauges at all four sites identified above.

A Frisbee gauge consists of an inverted shallow dish mounted on a pole approximately 1.75 m above the ground. A bird guard consisting of steel rods and nylon thread covers the dish to prevent birds from sitting on the gauge. The Frisbee collects deposited matter and matter insoluble in rainwater. The matter then gathers in a sample container at the bottom of the pole.

Deposited and insoluble matter in the rainwater collection are removed and separated by gentle vacuum filtration at a suitably accredited laboratory to provide a quantitative sample. Insoluble matter is dried and determined gravimetrically expressed as mg/m2/day.

Frisbee gauges will be changed every month. One year of baseline data will be collected prior to construction works to provide a baseline of deposition under different meteorological conditions.

Visual Observations

Visual observations are also proposed as an additional monitoring technique.

Visual observations are proposed as these can detect coarser particles, which may cause an off-site dust nuisance, following mobilisation and migration across site boundaries. Visual observations are also quick, without any delay from laboratory testing or data reviews. The findings of visual observations can therefore be acted upon quickly.

As a minimum visual observations will be undertaken by the site manager, or a designated person each day on-site and at site boundaries, with particular reference to the identified sensitive receptors. These observations will be recorded in a site log.

Site staff will also be trained to observe ground conditions, identify dust risks and increase mitigation as works progress.

8.3.3 Air Quality Thresholds

Three types of air quality threshold are described below for ambient suspended particulates, deposited dust and visual observations.

Ambient Suspended Particulate Sampling

The concentration of particulates will be compared to the following key criteria from the Daily Air Quality Index [xxiv], as reproduced from the National Air Quality Archive (see Table 8.1). Monitored concentrations of PM_{10} should ideally be below 50 µg/m³ over 24-hours and at worst this should not be exceeded more than 35 times a year over 24-hours.

The below index is provided to indicate how any concentrations above 50 µg/m³ will be described in reports.

Additionally, the London Best Practice Guidance for the Control of Dust and Emissions from Construction and Demolition (2014) [xxv] suggest a site action limit of 250µg/m^3 of PM_{10} over a 15-minute average.

The above criteria focus on short term exceedances, which are most applicable to manage mitigation efforts. For the purposes of annual reporting PM_{10} and $PM_{2.5}$ annual averages will also be reported and compared to annual AQS values (e.g. 40 µg/m² and 25 µg/m³).

Table 8.1 Daily Air Quality Index for PM_{10} and $PM_{2.5}$

Air Pollution Banding	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	Index Range	Accompanying health messages for at-risk groups and the general population	
				At-risk individuals	General population
Low	0 to 49	0 to 34	1-3	Enjoy your usual outdoor activities.	Enjoy your usual outdoor activities.
Moderate	50 to 74	35 to 52	4-6	Adults and children with lung problems, and adults with heart problems, who experience symptoms, should consider reducing strenuous physical activity, particularly outdoors.	Enjoy your usual outdoor activities.
High	75 to 99	53 to 69	7-9	Adults and children with lung problems, and adults with heart problems, should reduce strenuous physical exertion, particularly outdoors, and particularly if they experience symptoms. People with asthma may find they need to use their reliever inhaler more often. Older people should also reduce physical exertion.	Anyone experiencing discomfort such as sore eyes, cough or sore throat should consider reducing activity, particularly outdoors.
Very High	Greater than 100	Greater than 70	10	Adults and children with lung problems, adults with heart problems, and older people, should avoid strenuous physical activity. People with asthma may find they need to use their reliever inhaler more often.	Reduce physical exertion, particularly outdoors, especially if you experience symptoms such as cough or sore throat.

Dust Deposition

No statutory or official air quality criteria for dust annoyance has been set by the UK, European Union (EU) or World Health Organisation (WHO). Table 8.2 illustrates a number of standard guideline deposition rates.

Although there are no official criteria in England and Wales, a custom and practice limit of 200 mg/m^2/day recommended by the Environment Agency is proposed for comparison with the depositional dust gauge measurements at the site. It is proposed that 200 mg/m^2/day is used as a threshold indicating when mitigation should be reviewed.

Table 8.2 Guidelines for the Assessment of Dust – Deposition Rates (Technical Guidance Note M17) [v]

Source	Description of Guideline	Numerical Value (mg/m^2/day)
Environment Agency TGD M17	A custom and practice limit	200
Nuisance Standard Washington State, USA	Residential areas	187
Western Australia	Loss of amenity first perceived Unacceptable reduction in air quality	133 333
Nuisance Standard West Germany (TA Luft Vol. 27.2.1986)	Possible nuisance Complaints very likely	350 650
Stockholm Environmental Institute	Rural Areas Town Centres	140 260

Visual Observations

Visual observations should be used to identify areas of dust mobilisation on-site, which require further mitigation (e.g. further water suppression), prior to migration across site boundaries. See Section 8.3 for details of dust mitigation measures.

8.3.4 Air Quality Exceedance Procedures

Where the results of monitoring indicate that air quality thresholds are being exceeded at one or more sensitive receptors, the site manager will be notified and advice will be provided to reduce air quality emissions and off-site impacts so far as is practicable. The remedial actions taken in these circumstances must be noted and reported to the Mineral Planning Authority.

Local residents will be informed in advance of expected particularly dusty works by the site manager or appointed site liaison officer, including details of activities being undertaken, the expected times of activities and expected durations.

8.3.5 Response to Complaints

Should complaints arise from nearby residents regarding air quality from general construction activities, a log of the complaint in a specific complaint register will be made, including:

- the date and time that the complaint was received by the site;
- the nature of the complaint; and
- the name, address and telephone number of the complainant.

The complainant will be contacted as soon as is practicable by the site manager or appointed site liaison officer to discuss the complaint.

Site activities will be reviewed together with the mitigation in place at the time of any compliant.

Air quality monitoring data and on-site meteorological data will also be reviewed to identify any data which may be available to establish the nature of any air quality issue.

If there has been a failure in mitigation then remedial action will be undertaken to restore mitigation.

8.3.6 Reporting

Details of air quality monitoring will be sent to Copeland Borough Council within eight weeks of the completion of baseline monitoring or at the end of each year of operational monitoring:

The following information will be included:

- planning condition reference and related air quality thresholds;
- precise monitoring locations (including photographs);
- dates and times of measurements;
- equipment type (including serial numbers, where applicable);
- details of ongoing site activities throughout the monitoring period;
- details of all air quality pollutant sources;
- comparison of measured levels with the air quality thresholds, and resultant conclusion; and
- any other relevant observations.

The details of any remedial action taken as a result of the measurements will also be forwarded to Copeland Borough Council.

8.4 Operation

No operational mitigation or monitoring measures are recommended as no significant effects are anticipated with respect to air quality from the Operation of the site.

9 Residual Effects

This Section discusses the anticipated level of effect following implementation of the aforementioned mitigation measures.

Any effects associated with construction dust are predicted to be negligible as best practice dust mitigation and monitoring measures will be utilised.

The residual effect associated with construction site plant is expected to be negligible at the nearest residential and ecological receptors.

Traffic emissions associated the proposed development are negligible, as there are small numbers of vehicles associated with the works.

Rail emissions associated the proposed development are negligible, as there are small numbers of movements associated with the proposed development and no relevant exposure within 15m.

There are negligible changes in emissions due to the variations proposed in operational conditions e.g. higher stacking.

The residual effects associated with each aspect that has been assessed are described in Table 9.1.

Table 9.1 Summary of Effects Following Mitigation

Phase	Nature of Effect	Temporal and Spatial Extent	Significance
Site Works (e.g. construction, capping, vegetation removal, earthworks)	Plant emissions	Temporary, Local	Negligible
	Increase in fugitive dust emissions	Temporary, Local	Negligible
	Additional traffic emissions	Temporary, Local	Negligible
	Rail freight emissions	Temporary, Local	Negligible
Operation	Disposal of waste in Vaults 9 to 11	Permanent, Local	Negligible
	High stacking in Vaults 8, 9 10 and 11	Permanent, Local	Negligible

10 Cumulative Effects

The installation of security fencing is currently in progress and is programmed to be completed by 2017.

Demolition works are to be undertaken at the PCM retrieval facilities and magazines, commencing in 2018.

These works are not part of the planning permission which this assessment supports. Therefore, the effects of these works are considered in this cumulative effects section.

The Phase 1, site preparation works, assessed in Section 6 will be on-going when the installation of the security fences is undertaken. During the demolition of magazines, certain Phase 2 works will be ongoing.

This section considers the potential cumulative effects from both sets of works in relation to dust generation (PM_{10}).

The installation of security fencing is envisaged to have similar or lesser effects on PM_{10} concentrations than the works assessed for Phase 1a. Assuming an individual contribution of 3 µg/m³ at the site boundary for both works, total concentrations would still be well below the short term PM_{10} air quality objective, with a total short term PM_{10} concentration of 25 µg/m³. Both works would be subject to environmental controls to mitigate dust generation and as such no significant cumulative effects are anticipated from this combination of works.

Demolition works in the BRE study were identified to result in an increase in the PM_{10} 24-hour concentration of 11 µg/m³ at a site boundary, with concentrations decreasing to background concentrations at distances over 150 m. In this instance the demolition works are to be undertaken at distances over 200 m from all the sensitive human health receptors identified around the site. Therefore, these demolition works alone at the PCM retrieval facilities and magazines are anticipated to have a negligible significance.

Similarly, the assessment of construction works in 2020 for the new Vault (9A) are also to be undertaken at distances over 200 m from all the human health sensitive receptors identified around the site. Therefore, these works alone are anticipated to have a negligible significance.

Therefore, as both demolition and construction works are to be undertaken at distances greater than 200 m from sensitive receptors, the cumulative impact on PM_{10} 24-hour concentrations is considered to be the same as the individual assessments, with a negligible significance.

11 Summary

In summary, as the air quality significance of effects is considered to be negligible and exceedances of relevant air quality objectives, including those for PM_{10} are unlikely. The proposed development is considered to comply with the relevant air quality policies and plans described in the planning policy context Section of this Appendix.

The assessment has confirmed that:

- No properties are predicted to be affected by slight, moderate or major air quality impacts.
- No new exposure is being introduced with the proposed development.
- No exceedances of an air quality objective or limit value are predicted.
- Uncertainty in the predictions undertaken has been minimised through the application of worst case assumptions.
- Cumulative impacts have been considered and no slight, moderate or major air quality impacts have been identified.

All construction and operational air quality effects following mitigation are considered to be negligible and therefore it is anticipated that air quality will not be a material planning consideration with respect to the above proposals.

However, it is acknowledged that without mitigation, significant air quality effects could be anticipated at receptors in close proximity to dust generating activities. Consequentially, air quality should be considered in any planning conditions for the Proposed Development. For example it is anticipated that appropriate control measures will be required as part of any planning conditions for the site (e.g. Construction Environmental Management Plan or CEMP).

It is also expected that appropriate air quality monitoring conditions to confirm the effectiveness of mitigation measures will also be required.

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