N4 Collooney to Castlebaldwin, *Proposed Road Development*

APPENDIX NO. 9.2

Construction Phase – Local Air Quality and Climate Assessment: Inside the CPO (Spoil Repositories)

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1 Construction Phase – Local Air Quality Assessment

1.1 Introduction

It is expected that construction of the *Proposed Road Development* could potentially generate the movement (transport volume) of circa. 735,000m^3 of soft geological material (including c. 307,000m^3 of peat and 234,000m^3 of organic clay) to identified locations predominantly within the CPO.

As outlined in Chapter 4 of this EIS it will be the contractors responsibility to deal with this material in accordance with the various statutory requirements, however, in order to quantify the effects such an activity will have on the receiving Air Quality Environment, this assessment examines the impact on air quality of transferring this material to the aforementioned sites which are described in further detail in section 4.10.2 of Chapter 4 and which are arising from the assessment carried out in the Spoil Management Report contained as Appendix 4.3 of volume 4. This includes seven sites within the CPO. The sites within the CPO involve the extraction of rock material and the deposition of peat/organic clay material.

The worst-case maximum deposition rate has been used in the model in order to conservatively estimate the impact of the repository activities on the surrounding environment. For the purpose of the assessment it was assumed that all sites were being used simultaneously in order to provide a worst-case result.

In terms of the detailed operation of the material transfer, an excavator will excavate the material and load it onto trailers drawn by tractors, which will transport the material to the relevant deposition site where the material will then be unloaded.

For the purpose of the assessment, it is estimated that on a worst-case working day there will be a maximum of 22 tractor movements in and out of each site per hour. The proposed hours of operation are: Monday to Saturday 8:00am to 6:00pm and Sunday - closed.

The following operations are likely dust generating sources or activities for the *Proposed Road Development*:

1) Movement of empty trucks along paved public roads
2) Movement of empty trucks along unpaved haul roads
3) Loading and unloading of material
4) Movement of full trucks along unpaved haul roads
5) Movement of full trucks along paved public roads

1.2 Assessment Methodology

The air dispersion modelling input data consisted of information on the physical environment, design details from all emission sources and meteorological data. Using this input data the model predicted ambient ground level concentrations and deposition rates beyond the site boundary for each hour of the modelled meteorological year. The model post-processed the data to identify the maximum of the worst-case ground level concentrations. The worst-case concentrations and deposition rates were then added to the background concentration and deposition rate to give the worst-case predicted environmental concentration (PEC) and deposition flux for the worst-case receptor near each site. The PEC was then compared with the relevant ambient air quality standards to assess the significance of the releases from the extraction and repository activities.

1.3 Dispersion Modelling Methodology

In order to assess the dust deposition levels and the PM_{10} and $PM_{2.5}$ concentrations at sensitive locations beyond the site boundaries associated with the proposed activities, air dispersion modelling was undertaken. Modelling using the United States Environmental Protection Agency (USEPA) new generation dispersion model AERMOD[(A1)] was used as recommended by the USEPA[(A2)]. The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources. The model has been designated the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and rolling terrain[(A2)]. The AERMET PRO meteorological pre-processor[(A3)] was used to generate hourly boundary layer parameters for use by AERMOD. Dust generation rates were calculated from factors derived from empirical assessment and detailed in the USEPA database entitled "Compilation of Air Pollution Emission Factors", Volume 2, AP-42 (USEPA 1986, updated periodically). The emission factors have been presented below.

Road Haulage (Unpaved)

$E = [281.9*k*(s/12)^{a}(W/3)^{b}((365-P)/365)$ g/veh km

Where:

s = surface silt content (8.5%)

k = 4.9 (Total Dust), 1.5 (PM_{10}), 0.15 ($PM_{2.5}$)

W = mean vehicle weight (24 tonnes)

a = 0.9 ($PM_{10}/PM_{2.5}$), 0.7 (Total Dust)

b = 0.45

P = wet days (218 wet days)

Road Haulage (Paved)

$E = [k*(sL)^{0.91}*(W)^{1.02}](1-(P)/4N)$ g/veh km

Where:

sL = surface silt loading (0.6 g/m^{2})

k = 24 (Total Dust), 4.6 (PM_{10}), 0.66 ($PM_{2.5}$)

W = mean vehicle weight (24 tonnes)

P = wet days (218 wet days)

N = 365 days

Material Loading

$E = k(0.0016)*(U/2.2)^{1.3}/(M/2)^{1.4}((365-P)/365)$ kg/Mg

Where:

k = 0.74 (Total Dust), 0.35 (PM_{10}), 0.053 ($PM_{2.5}$)

M = moisture content (10%)

U = mean wind speed (4 m/s)

P = wet days (218 wet days)

1.3.1 Process Emissions

Dust is characterised as encompassing particulate matter with a particle size of between 1 and 75 microns (1-75µm). Deposition typically occurs in close proximity to each site and potential impacts generally occur within 500 metres of the dust generating activity as dust particles fall out of suspension in the air. Larger particles deposit closer to the generating source and deposition rates will decrease with distance from the source. Sensitivity to dust depends on the duration of the dust deposition, the dust generating activity, and the nature of the deposit. Therefore, a higher tolerance of dust deposition is likely to be shown if only short periods of dust deposition are expected and the dust generating activity is either expected to stop or move on.

The potential for dust to be emitted will depend on the type of activity being carried out in conjunction with environmental factors including levels of rainfall, wind speed and wind direction. This report identifies and quantifies the dust sources and remedial action necessary to minimise dust exposure for this project.

1.3.2 Dust Generation Rates

Dust generation rates depend on the site activity, particle size, the moisture content of the material and weather conditions. Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion created between dust particles and water and the removal of suspended dust from the air. It is typical to assume no dust is generated under “wet day” conditions where rainfall greater than 0.2mm has fallen. Information collected from Clones Meteorological Station (1978-2007) identified that typically 218 days per annum are “wet”.

Large particle sizes (greater than 75 microns) fall rapidly out of atmospheric suspension and are subsequently deposited in close proximity to the source. Particle sizes of less than 75 microns are of interest as they can remain airborne for greater distances and give rise to the potential dust nuisance at the sensitive receptors. This size range would broadly be described as silt. Emission rates are normally predicted on a site-specific particle size distribution for each dust emission source. For the purpose of modelling deposition for this assessment, the particle size breakdown outlined in AP-42[(A4)] for mechanically generated aggregate has been used. The moisture content of the spoil material has been estimated as 10%.

1.3.3 Meteorological Data

Meteorological conditions significantly affect the level of dust emissions and subsequent deposition downwind of the source. The most significant meteorological elements affecting dust deposition are rainfall and wind-speed. High levels of moisture either retained in soil or as a result of rainfall help suppress the generation of dust due to the cohesive nature of water between dust particles. Rain also assists in removing dust from the atmosphere through washout. Wind can lift particles up into the air and transport the dust downwind as well as drying out the surface. The worst dust deposition conditions typically occur therefore during dry conditions with strong winds.

Rainfall & wind speed data collated over a thirty-year period (1978-2007) at Clones Airport Meteorological Station have been reviewed to identify typical rainfall and wind patterns for each month of the year. Where rainfall is greater than 0.2mm per day, no dust is assumed generated due to the suppressing effects of rain. On average approximately 218 days have rainfall greater than 0.2mm, which has been used in the assessment.

The AERMOD air dispersion model requires hourly meteorological data in a specific format as a model input. Suitable meteorological data was obtained from Clones Meteorological Station for the period 2002– 2006. Precipitation rates for the year 2004 were used to identify the dust deposition levels.

1.3.4 Sensitive Locations

Dust deposition typically occurs in close proximity to the dust-generating source. Sensitive locations were identified in the vicinity of the recovery sites for use in the model. These sensitive receptors are generally within 100m of a deposition site or haul route and have potential to be affected by dust deposition.

Generally, the potential for severe dust impacts is greatest within 100m of dust generating activities, though residual impacts can occur for distances beyond 100m. The nearest residential receptors would, however, be considered low sensitivity locations in comparison to a high sensitivity location such as a hospital, high density residential, school or crèche.

1.4 Impact of Extraction and Deposition Processes on Local Air Quality

The emissions from the extraction and deposition processes lead to a dust deposition level averaged over the full year of 30.5 mg/(m^2*day) at the worst-case receptor (see Table A9.2.1). Based on a background deposition rate of 59 mg/(m^2*day) in the region of the subject site, the combined dust deposition level including the proposed peat deposition peaks at 89.5 mg/(m^2*day) which is only 26% of the TA Luft Limit Value of 350 mg/(m^2*day).

Predicted PM_{10} concentrations are significantly lower than the ambient air quality standards at the nearest residential receptors (see Table A9.2.1). The predicted 24-hour and annual concentrations (excluding background) at the worst-case receptor peak at 13.2 and 5.63 µg/m^3 respectively. Based on a background PM_{10} concentration of 15 µg/m^3 the combined annual PM_{10} concentration including the proposed peat deposition peaks at 20.63 µg/m^3. This predicted level equates to at most 52% of the annual limit value of 40 µg/m^3. The predicted 24-hour PM_{10} concentration (including background) peaks at 28.2 µg/m^3 which is 56% of the 24-hour limit value of 50 µg/m^3 (measured as a 90th%ile).

Predicted $PM_{2.5}$ concentrations at the nearest residential receptors are significantly lower than the limit value of 25 µg/m^3 which will be in place after 2015 (see Table A9.2.1). The predicted annual concentration (excluding background) at the worst-case residential receptor peaks at 0.47 µg/m^3. Based on a background $PM_{2.5}$ concentration of 9.8 µg/m^3 in the region of the facility, the annual $PM_{2.5}$ concentration including the proposed peat deposition operations peaks at 10.27 µg/m^3. This peak level equates to 41% of the annual limit value for $PM_{2.5}$.

Table A9.2.1 Modelled Dust Deposition Level, PM_{10} Concentration and $PM_{2.5}$ Concentration Resulting From The Proposed Extraction and Deposition Processes

Pollutant	**Predicted Deposition and Concentration** Note 1		**Limit Value**
	Excl. Bkg	**Incl. Bkg** Note 2	
Dust Deposition (Worst-case Residential Receptor)	30.5	89.5	350 Note 3
PM_{10} - Annual Average (Worst-case Residential Receptor)	5.63	20.63	40 Note 4
PM_{10} - Maximum 24-hr (90th%ile) (Worst-case Residential Receptor)	13.2	28.2 Note 6	50 Note 5
$PM_{2.5}$ - Annual Average (Worst-case Residential Receptor)	0.47	10.27	25 Note 4

Note 1 Units: dust deposition - mg/(m^2*day); PM_{10} / $PM_{2.5}$ - µg/m^3

Note 2 Includes background concentrations: dust deposition = 59 mg/(m^2*day); PM_{10} = 15 µg/m^3; $PM_{2.5}$ = 9.8 µg/m^3

Note 3 TA Luft Dust Deposition Limit = 350 mg/(m^2*day)

Note 4 EU Council Directive 2008/50/EC (S.I.180 of 2011). Annual average limit value

Note 5 EU Council Directive 2008/50/EC (S.I.180 of 2011). 24-hr limit of 50 µg/m^3 not to be exceeded >35 times/year (90.4th%ile)

Note 6 Short-term peak concentration calculated in accordance with guidance from the UK DEFRA (UK DEFRA 2009a)

2 Construction Phase – Climate

2.1 Assessment Methodology

The greenhouse gas emissions associated with peat extraction and abandonment has been assessed using the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, Chapter 7 Wetlands (IPCC, 2006). Based on estimates already discussed in Section 9.1.4 of the Air Quality and Climate Change chapter, it is estimated that peat may be spread on c. 6.6ha of land within the confines of the *Proposed Road Development*. Some peat may be used to enhance unsuitable material for the purposes of landscaping within the *Proposed Road Development*, however, the peat material is generally of limited re-use value on the *Proposed Road Development* and therefore a significant quantity will need to be dealt with. It is proposed that the residual peat will be deposited at the sites already described in Section 9.1.4 within the limits of the CPO.

The guidelines are designed to estimate and report on national inventories of anthropogenic Greenhouse Gas (GHG) emissions and removals in order to ensure compliance with the Kyoto Protocol. Anthropogenic refers to GHG emissions and removals that are a direct result of human activities or are a result of natural processes that have been affected by human activities (IPCC, 2006). The quantity of carbon from natural cycles through the earth's atmosphere, waters, soils and biota is much greater than the quantity added by anthropogenic GHG sources. However, the focus of the UNFCCC and the IPCC is on anthropogenic emissions because it is these emissions that have the potential to alter the climate by disrupting the natural balances in carbon's biogeochemical cycle, and altering the atmosphere's heat-trapping ability. The carbon from biogenic sources such as pristine peatland was originally removed from the atmosphere by photosynthesis, and under natural conditions, it would eventually cycle back to the atmosphere as CO_2 due to degradation processes. Thus, these sources of carbon are not considered anthropogenic sources and do not contribute to emission totals considered in the Kyoto Protocol (IPCC, 2006). The guidelines do however outline a methodology to calculate the anthropogenic greenhouse gas emissions associated with the extraction and abandonment of peat. This methodology has been used to assess the potential impact on climate from the *Proposed Road Development* by quantifying the carbon dioxide (CO_2) emissions from the deposition of peat during construction of the road.

The on-site removal and subsequent abandonment of peat can be calculated based on the formula below (IPCC, 2006):

$$CO_{2peat\ on\text{-}site} = [(A_{peatRich}\ x\ EF_{CO2\ peatRich}) + (A_{peatPoor}\ x\ EF_{CO2\ peatPoor})]*44/12$$

where:

$CO_{2peat\ on\text{-}site}$ = *on-site* CO_2 *emissions from peat deposits (all production phases) tonnes* yr^{-1}

$A_{peatRich}$ = *area of nutrient-rich peat soils managed for peat extraction (all production phases), ha*

$A_{peatPoor}$ = *area of nutrient-poor peat soils managed for peat extraction (all production phases), ha*

$EF_{CO2peatRich}$ = *CO_2 emission factor for nutrient-rich peat soils managed for peat extraction or abandoned after peat extraction, tonnes C ha^{-1} yr^{-1} (default of 1.1 tonnes C ha^{-1} yr^{-1})*

$EF_{CO2peatPoor}$ = *CO_2 emission factor for nutrient-poor peat soils managed for peat extraction or abandoned after peat extraction, tonnes C ha^{-1} yr^{-1} (default of 0.2 tonnes C ha^{-1} yr^{-1})*

Using a worst-case assumption that all peat is nutrient-rich leads to the following emission total for CO_2 emissions during the construction phase of the *Proposed Road Development*:

$$CO_{2peat\ on\text{-}site} = (6.6\ ha \times 1.1\ C\ ha^{-1}\ yr^{-1})*44/12 = 27\ tonnes\ CO_2\ /\ annum$$

Similarly, for N_2O, the greenhouse gas emissions associated with the extraction and deposition of peat can be estimated based on the formula:

$$N_2O_{peat\ extraction} = [(A_{peatRich} \times EF_{N2O\text{-}N\ peatRich})]*44/28*10^{-3}$$

where:

$N_2O_{peat\ extraction}$ = *direct N_2O emissions from peatlands managed for peat extraction, tonnes N_2O yr^{-1}*

$EF_{N2O\text{-}N\ peatRich}$ = *emission factor for drained nutrient-rich wetlands organic soils, kg N_2O-N ha^{-1} yr^{-1} (default = 1.8 kg N_2O-N ha^{-1} yr^{-1})*

Again, using a worst-case assumption that all peat is nutrient-rich leads to the following emission total for N_2O emissions during the construction phase of the *Proposed Road Development*:

$$N_2O_{peat\ extraction} = [(6.6\ ha \times 1.8\ kg\ N_2O\text{-}N\ ha^{-1}\ yr^{-1})]*44/28*10^{-3} = 0.019\ tonnes\ N_2O$$

Methane emissions from peat extraction and abandonment are considered negligible by the IPCC (IPCC, 2006).

GHGs have different efficiencies in retaining solar energy in the atmosphere and different lifetimes in the atmosphere. In order to compare different GHGs, emissions are calculated on the basis of their Global Warming Potential (GWPs) over a 100-year period, giving a measure of their relative heating effect in the atmosphere. The GWP100 for CO_2 is the basic unit (GWP = 1) whereas CH_4 has a global warming potential equivalent to 21 units of CO_2 and N_2O has a GWP100 of 310. Thus the overall greenhouse gas emissions from the construction phase of the *Proposed Road Development*, based on converting all emissions to an equivalent CO_2 emission, are:

*GHG Emissions From Peat Removal & Abandonment = 27 tonnes CO_2 + (0.019 tonnes N_20)*310*

GHG Emissions From Peat Removal & Abandonment = ***33 tonnes CO_2eq***

2.2 Impact of Peat Deposition on Climate

The emissions from peat removal and deposition have been compared with the estimated total GHG emissions in Ireland in 2010 based on compliance with the Kyoto Target (DEHLG, 2000). The contribution to the total GHG emissions (which is assumed to be 62.8 million tonnes CO_2eq in 2010 (i.e. the Kyoto Target) is 0.00005% of the total in Ireland in that year and thus is an insignificant source of greenhouse gas emissions.

3 References

(A1) USEPA (2004a) AERMOD Description of Model Formulation

(A2) USEPA (2005) Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1

(A3) USEPA (2004b) User's Guide to the AERMOD Meteorological Preprocessor (AERMET)

(A4) USEPA (2013) Emissions Factors and AP 42, *Compliation of Air Pollution Emission Factor.* http://www.epa.gov/ttnchie1/ap42/