12AIR AND CLIMATE

12.1 INTRODUCTION

This section presents an assessment of impacts on air quality and climate arising from the proposed development, predicts the potential impacts on the surrounding environment arising from the construction and operation of the proposed development and specifies mitigation measures to reduce potential impacts where appropriate.

This chapter has been prepared by the following authors:

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12.2 METHODOLOGY

The air and climate evaluation was desk based and comprised of a review of maps and aerial photography to define baseline influences on air quality in study areas and the presentation of known impacts associated with the provision of overhead transmission lines and substations.

Published reports regarding air quality were also reviewed as follows:

- Air Quality in Ireland (2011) – Key Indicators of Ambient Air Quality (published in 2012)
- Air Quality Standards Regulations 2011 (S.I No 180 of 2011)
- Glanbia (Ballyragget) IPPC Licence

Regard has also been made to the European Commissions 'Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment' in the preparation of this section.

12.3 RECEIVING ENVIRONMENT

12.3.1 AIR QUALITY

12.3.1.1 Legislative Context

In order to protect human health, vegetation and ecosystems, EU Directives have been adopted which set down air quality standards for a wide variety of pollutants. The current standards are contained in the Cleaner Air for Europe (CAFE) Directive and the 4th Daughter Directive. These Directives also include rules on how Member States should monitor, assess and manage ambient air quality.

EU Directive 2008/50/EC on ambient air quality and cleaner air for Europe was adopted in 2008. This CAFE Directive merges earlier Directives on limit values for a range of air quality parameters and one Council Decision into a single Directive on air quality. The CAFE Directive was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011). The Fourth Daughter Directive was transposed by the Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations 2009 (S.I. No 58 of 2009).

The EPA is an independent public body charged with the statutory protection of the environment in Ireland. In conjunction with individual local authorities, it undertakes ambient air quality monitoring at specific locations throughout the country in the urban and rural environment. It prepares an annual air quality report based on data from 29 monitoring stations and a number of mobile air quality monitoring units.

EU legislation on air quality requires that member states divide their territory into zones for the assessment and management of air quality. Ireland is divided into four such zones. Zone A is the Dublin conurbation, Zone B is the Cork conurbation, Zone C comprises large towns in Ireland with a population

>15,000 and Zone D, principally rural, is the remaining area of Ireland. The majority of the proposed development site is located in Zone D. Kilkenny City is classed as Zone C.

12.3.1.2Baseline Air Quality

Air quality in Zone D areas is generally very good with low concentrations of pollutants such as Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2) Particulate Matter 10 microns in size (PM_{10}), and Carbon Monoxide (CO). This is due mainly to the prevailing clean westerly air-flow from the Atlantic and the relative absence of large cities and heavy industry. Concentrations of ozone are higher in rural areas than in urban areas due to the absence of the nitrogen oxide in rural areas as an ozone scavenger. Ozone is also a transboundary pollutant, with locations on the west coast having the highest concentrations in Ireland.

The most recent report, Air Quality in Ireland (2011) – Key Indicators of Ambient Air Quality, indicates that overall, air quality in Ireland continues to be of good quality and remains the best in Europe. Measured values of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), heavy metals, benzene and polycyclic aromatic hydrocarbons (PAH) were all below limit and target values set out in the CAFE Directive and 4th Daughter Directive. The report noted, however, that levels of particulate matter and NO_2, PAH and to a lesser extent ozone, continue to remain a concern. PAHs arise from domestic fuel burning and vehicle exhaust emissions.

The proposed developments are located in the rural Zone D. A summary of air quality parameters and air quality assessment for Zone D taken from the EPA Annual Report 2011 is provided in Table 12.1.

Parameter	Lower Assessment Threshold	Limit Value	Number of national Monitoring Locations	Number of Zone D Monitoring Locations	Zone D result
NO_2 and NOx	26ug/m^3	200ug/m^3 one hour -, Calendar year 40ug/m^3	13	4	Below the annual limit value and the lower assessment threshold
SO_2	50 ug/m^3	125 ug/m^3/d one day human beings/ / 20ug/m^3 calendar year vegetation	10	3	Below the daily limit value for human beings and vegetation and the lower assessment threshold
CO	5 mg/m^3	8 hour - 10 mg/m^3 (human beings	5	1	Below the annual limit value and the lower assessment threshold
Ozone	Daily maximum 8 hour mean - 120 ug/m^3 over 25 days per year/Long term objective 120 ug/m^3	Daily maximum 8 hour mean - 120 ug/m^3 human beings/18,000 ug/m^3/h for vegetation. Information to be supplied at 180 ug/m^3	12	6	Below the annual target value and above long term objective on one day
Particulate Matter (PM_{10}, and Black Smoke)	25 ug/m^3 (one day)/20 ug/m^3 (calendar year)	One day 50 ug/m^3, Calendar year 40ug/m^3	17	4	Below the annual limit values and above the lower assessment threshold

Particulate Matter $PM_{2.5}$ ug/m^3	12 ug/m^3 averaged over a calendar year	25ug/m^3 average over a calendar year	7	2	Below both the annual limit value and the lower assessment threshold.

Table 12.1: Summary of Air Quality Assessment in Zone D.

The 2011 Air Quality report contains results from the monitoring period April 2010 – March 2011. The transport sector is identified as the primary source of NO_2 and is also one of the main sources of particulate matter. Domestic solid fuel use is also identified as a main source of particulate matter in air in Ireland. As a result, levels of particulate matter in smaller towns are similar or higher than those in cities, where bituminous coal is banned.

The nearest air monitoring stations to the project sites are located at Emo, Co. Laois (Zone D) and Seville Lodge, Co. Kilkenny (Zone C). The most recent data from the EPA's website from published bulletins in 2012 is presented in Table 12.2. Both sites monitor NO_2 and Ozone. There have been no exceedances of air monitoring parameters at the two monitoring stations.

Parameter	Station	Assessment	Number of times limit exceeded
NO_2	Emo Kilkenny	Number of values greater than 200 ug/m^3	0 0
Ozone	Emo Kilkenny	Number of values greater than 180 ug/m^3	0 0

Table 12.2: EPA 2012 Air Quality Bulletin for monitoring stations in Laois and Kilkenny

In general, it can be concluded that Ireland has a good standard of air quality. It is assumed that since air quality targets are being met across the country, particularly in the monitored urban settings closest to the subject site, then air quality targets will also be satisfactory in the area around the subject site.

The project area is located in a rural area with one industrial emission source located nearby in Ballyragget. Glanbia Ingredients Limited is located within one kilometre from the Ballyragget proposed substation. The plant is located on the opposite side of the river Nore, on the N77 between Ballyragget and Durrow. Glanbia operate the plant under the Integrated Pollution and Prevention Control Licence (IPPCL) (P0359-03). Ambient air quality is influenced by emissions from the Glanbia Plant in the vicinity of Ballyragget, agricultural activity, domestic heating and vehicle emissions. The most recent EPA PRTR (Pollution Release and Transfer Register) data for the plant is 2011 which concluded that all air emissions were below reporting thresholds as set in their IPPC Licence and do not give rise to exceedances of air quality in the area.

At present, the bulk of the land surrounding the subject sites are primarily agricultural land. The closest receptors and dwelling house distances to substations are shown in Table 12.3.

Location	Receptor	Approximate Distance (m)
Coolnabacky	Dwelling/Farm	821
Ballyragget	Dwelling	134
	Cemetery	<40
	Glanbia Plant	720
Kilkenny	Dwelling	185

Table 12.3 Nearest receptors to Substations

The primary existing source of air emissions at substation sites comes from passing traffic, including farm machinery, natural land use and HGV's with the exception of Ballyragget, where an additional source of air emissions is the Glanbia plant. The 2011 Annual Environmental Report (AER) for the plant concluded

that all air emissions were within the Environmental Limit Value (ELV) thresholds as set in their IPPC Licence and as such do not give rise to exceedances of air quality in the area.

12.4 POTENTIAL IMPACT

12.4.1 DO NOTHING IMPACT

In a 'Do Nothing' scenario, the general air quality of the area would continue to be similar to existing conditions. There would be no change to the existing environment.

12.4.2 POTENTIAL IMPACT FROM PROJECT

12.4.3 AIR QUALITY

12.4.3.1 Construction Impacts

The main potential impact to air quality at construction sites will come from dust which could potentially have an effect on aesthetic surroundings or cause a nuisance due to reduced visibility, soiling of gardens, buildings or vegetation and impairment of air quality.

Dust can be generated from construction site works principally at substations and along access routes to overhead line construction sites. Dust will be associated with ground disturbance caused by construction vehicles and from emissions from vehicles and equipment. Sources of dust include:

- Vehicle exhaust emissions
- Site preparation works including topsoil removal and storage, rock breaking and contouring
- Disturbed ground
- Storage of excavated materials on site.
- Removal of excess spoil from the construction site
- Delivery of road making materials and construction of the access road
- Concrete foundation work involving delivery of concrete loads, formwork concrete pouring and vibration
- Delivery of materials for substation construction
- Construction of the substation building and fitting out
- Delivery and installation of the substation transformers
- Construction of earthen berms and landscaping.

Impacts will be short term and can be controlled using good site practice and good engineering construction practices during the construction phase.

As a general rule, dust nuisance is not expected at a distance beyond 250m from the work activity and then only when the receptors are downwind of the construction work. The effects of dust will depend on applied mitigation measures, prevailing winds, weather conditions and natural screening such as trees, hedges or vegetation or physical screening such as boundary walls.

Proposed Coolnabacky 400/110kV Substation (Unit 1): The proposed substation at Coolnabacky will be situated approximately 1.3km from the Regional road R426. To prevent dust becoming a nuisance on roads during the construction phase, dust suppression methods will be used to eliminate dust prior to vehicles joining the R426 road. Dust suppression methods are listed in the mitigation measures of construction phase in Section 12.5.1.1.

Table 12.3 shows there are no dwelling houses within 800 metres of the proposed substation however cognisance must be taken to prevent dust becoming a nuisance on the laneway. Dust suppression will be used within the site so as not to cause potential additional dust emissions on the access route.

Proposed Ballyragget 110/38kV Substation (Unit 4): The proposed substation at Ballyragget is adjacent to Ballyragget Cemetery on the Regional road R432. Should dust emissions occur at times when

the Cemetery is in use, works causing dust emissions will cease and dust suppression measures will be applied.

Table 12.3 shows that the distance from the nearest dwelling is approximately 134 metres from the proposed 110kV substation. To prevent dust becoming a nuisance on site or on the adjacent road during the construction phase, dust suppression methods will be used.

Existing Kilkenny 110kV Substation (Unit 7): Table 12.3 shows that the distance from the nearest dwelling to the existing substation is approximately 185 metres. To prevent dust becoming a nuisance during the construction phase, dust suppression will be used within the site.

Proposed Overhead Lines: Given the widespread nature of the construction sites, potential impacts from fugitive dust and resultant nuisance impacts are likely to be minor and any emissions will be temporary in nature and of a short duration.

Emissions to air from construction and staff vehicles travelling to and from the sites will also occur, with a relatively small number of additional vehicle movements per day predicted on roads adjacent to proposed substations or to access routes for overhead lines.

Construction plant and equipment will meet relevant national legislation with respect to emissions standards and this will be ensured through proper maintenance of equipment. The level of increased traffic along adjacent roads will be negligible relative to the existing traffic volumes and the resultant increased emissions to air will not result in significant air quality impacts on local residents. In addition, it is very unlikely that any breach of national air quality standards protective of human health will result from the increased traffic or construction activities given that national background concentrations are well below limit values.

12.4.3.2 Operational Phase

Following construction of the proposed substations and temporary access, emissions from the substation site will be limited to irregular and minimal vehicle movements. Although the site will be unmanned there will be routine inspections of the substation equipment and maintenance of the waste water collection systems. The emissions from these operational activities will be insignificant on receptors in the area.

12.4.4 GASEOUS OXIDANTS

Corona activity of a transmission/distribution line can produce small quantities of gaseous oxidants in air, such as ozone and nitrogen oxides.

Studies in laboratories and measurements near transmission lines have shown that transmission lines do not make any significant contribution to ambient atmospheric ozone levels (Electric Power Research Institute (EPRI) AC Transmission Line Reference Book – 200 kV and Above, Third Edition, 2005).

Ozone production from transmission networks is negligible on a national scale. Overhead transmission line contributions to ozone levels locally are typically negligible or a very small proportion of applicable ambient air limit values (< 2%).

Therefore, ozone production is not a significant impact of overhead lines.

12.4.5 CLIMATE

The design life of the electricity infrastructure is 50 to 60 years. During this period it is possible that climate change will alter the existing baseline environment. The design of the Laois – Kilkenny Reinforcement Project makes provision for potential impacts on this energy infrastructure due to for instance landslides, strong winds, flooding and fires (resulting from extreme weather events) or increase in average temperatures and sea level rise (as long term climate trends). It is anticipated that with routine maintenance of the infrastructure it will remain resilient throughout its life cycle against an evolving environmental baseline.

12.4.5.1Reduction in thermal losses on Network

Where electrical power is transported over long distances some of the power is dissipated along the conductor length which represents an actual loss of energy, called a thermal loss.

Improving the condition of the network can result in a reduction in thermal energy loss.

12.4.5.2 Forestry and Carbon Sequestration

Forests store carbon and have a key role to play in mitigating climate change.

The construction of the overhead line will result in the loss of commercial forestry with the consequent loss of carbon sequestration associated with this. This loss of carbon sequestration is likely to offset by the efficiencies in the transmission system resulting in reduced requirement for energy production from fossil fuels.

12.4.5.3 Sulphur Hexafluoride (SF_6)

It is proposed that the new Coolnabacky substation and Ballyragget substation will be a GIS (Gas Insulated Switchgear) Station and will use Sulphur Hexafluoride (SF_6) in electrical equipment. SF_6 is an insulating material used within high voltage electrical equipment because of its high dielectric strength and good thermal properties. It is non-flammable, non-corrosive to metals at ambient temperatures and non-toxic at steady state. The GIS switchgear will be enclosed in a building and equipment containing SF_6 will be hermetically sealed to prevent leakage.

SF_6 is a powerful greenhouse gas but the current amount in the atmosphere is small, contributing less than 0.1 percent to the total greenhouse effect. Global SF_6 is a very stable gas and therefore most emissions accumulate in the atmosphere. SF_6 is not an ozone depleting gas.

The use of SF_6 in electrical equipment has been an insulator of choice in Ireland for nearly 30 years, used in various forms of electric power equipment in the transmission and distribution sectors including circuit breakers, gas insulated switchgear (GIS) and air insulated switchgear (AIS).

Requirements of the EC Regulation 842 of 2006 on Certain Fluorinated Greenhouse Gases are addressed in *ESB Networks SF6 Gas Policy*. Specialised gas handling equipment is used when recovering contaminated SF6 gas from electrical equipment and the gas loss to atmosphere is minimal. The handling of SF6 gas is carried out by trained personnel, from a recognised certification body.

12.4.6 POTENTIAL DECOMMISSIONING IMPACTS

Decommissioning of the substation sites and overhead lines would involve demolition of the buildings and compounds and restoration of the sites. The impacts will be similar in decommissioning phase as the construction phase. Mitigation measures outlined in Section 12.5.1.1 will be applied during decommissioning. It is anticipated that impacts on air quality will not be significant during this phase of the project.

The dismantling and recovery of SF_6 electric power equipment will be completed by specialised trained personnel. SF_6 gas is collected by a compressor and transferred to storage containers as per ESB Networks procedures on the dismantling of SF_6 equipment.

12.4.7 CUMULATIVE IMPACTS

There are no known developments envisaged in the proposed areas, therefore the project will not give rise to significant impacts on air quality. No cumulative impacts are envisaged.

12.5 MITIGATION MEASURES

12.5.1.1 Construction Phase

Traffic-related effects, site excavation works and material storage are the principal potential sources of airborne dust and these can be managed through a comprehensive construction management plan for the sites, setting out the mitigation measures set out below and detailing how they will be enforced:

- Transport of materials to and from the sites will take place in normal working hours and along routes agreed with the local authority.
- Vehicle speeds will be restricted on haul roads.
- Vehicles will be routinely maintained to minimise emissions.
- Site haul roads will be dampened down with water during prolonged dry periods if necessary.
- Dusty materials such as excavated materials will be stored and handled appropriately (for example, by covering where necessary and minimising the drop heights of materials).
- Wheel-wash facilities of vehicles leaving site will be provided.
- Materials likely to be a source of dust will be transported in an appropriate manner (for example, by covering the load).
- Suitable hoardings will be used at the construction site to prevent dispersal of materials by wind.
- Site management practices will incorporate appropriate dust monitoring.
- All construction will be completed in a timely fashion.
- Bare areas will be re-vegetated on contractor's completion.
- Maintain plant and equipment to minimise fuel consumption.

Any impacts of construction on air quality will be of short duration and will be rendered negligible by implementation of these mitigation measures through the construction management plan.

12.5.1.2 Operational Phase

During the operational phase, there will be no significant impacts on receptors in the area and no specific mitigation measures are proposed.

12.6 RESIDUAL IMPACTS

This project will lead to a reduction in thermal (energy) losses on the network.

During the construction phase site works for the substations, dust and emissions will be associated with construction vehicles and equipment. These impacts will be short term and can be controlled using good site practice during the construction phase.

Apart from dust emissions associated with construction and demolition activities, the proposed new stations and overhead lines will not give rise to significant impacts on air quality.

12.7 NOISE

12.7.1 INTRODUCTION

This section has been prepared based on the noise report prepared by Biospheric Engineering Ltd. Overhead line noise calculations were produced by ESB International.

12.7.2 METHODOLOGY

Noise baseline surveys were carried out and a noise impact assessment was prepared in conjunction with Biospheric Engineering Ltd. The report assessed the likely noise impact of the development in the context of current relevant standards and guidance and identifies any requirements or possibilities for mitigation. A noise prediction model for transformer/substation noise at Coolnabacky was also prepared.

Noise measurements were taken using Bruel & Kjaer model 2260 and 2250 precision sound level meters.

Noise measurements were taken in accordance with International Standards Organisation ISO 1996 – Acoustics – Description and Measurement of environmental noise. This standard does not set an upper limit to the windspeed in which measurements are taken; it requires the reporting of the windspeed at the time of measurement.

12.7.3 RECEIVING ENVIRONMENT

One long-term, twenty-one short-term and additional short term monitoring measurements (including night time measurements) were undertaken in June/July 2012 in good weather conditions at various locations to determine background noise. Wind speeds and weather conditions during the measurement periods were within the requirements of *ISO 1996 Acoustics - Description and measurement of environmental noise* at all times.

12.7.3.1 Baseline Noise Monitoring

Short-term environmental noise monitoring was undertaken at 21 locations along the proposed line route and in the vicinity of proposed substation sites. All measurements were taken at sites on the public roadside or on ESB Property. Three sets of measurements were taken along the route as follows:

- A series of 20 minute measurements at locations along the proposed line route during the day on 27th and 28th June 2012
- 24 hour continuous measurement at the proposed Coolnabacky Substation site on 16th/17th July 2012
- Additional short term monitoring at Ballyragget Substation including night time measurements

The noise monitoring locations were chosen to give a good spread of geographic locations along the route and a good variety of background noise as it occurs along the route. Where the 110kV line is proximate to a national road, measurements were taken, on the road adjacent to the nearest settlement location. Noise monitoring locations are shown in Figure 12.1.

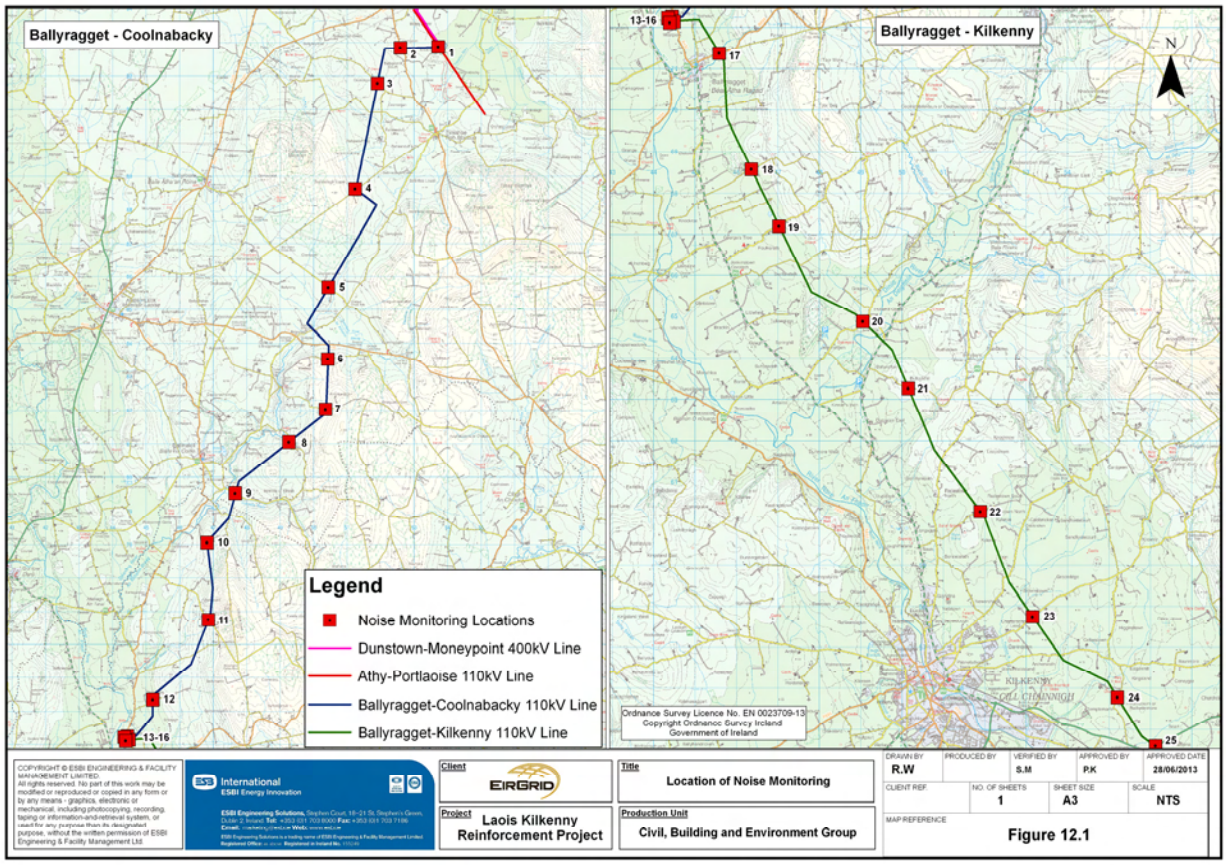

Figure 12.1 Noise Monitoring Locations

Proposed Coolnabacky Substation: The background noise levels at the Coolnabacky site are relatively low (L_{Aeq} levels measured at 37 dBA at night and 46 dBA during the day). The noise levels at nearby properties will be higher than this due to the relatively remote location of the site and the fact that most residential properties in the area face onto the road network.

Construction activity will take place during the day when background noise levels (L_{Aeq}) at the site are at 46 dBA. Background noise levels at residences in the area during the day are likely to be in the order of 62 dBA (based on measurements taken at the R426) due to proximity of residences to roads and traffic that are further removed from the proposed substation site.

Measured noise levels at the Coolnabacky site (Location 1) are presented in Table 12.4. Measured noise levels at site adjacent to Coolnabacky, along the proposed line route and at the Ballyragget substation site (locations 13, 14, 15 and 16) are presented in Table 12.5.

				dB(A)			
Site	**Date**	**Time**	**Location**	**L_{10}**	**L_{50}**	**L_{90}**	**L_{Aeq}**
1	28-Jun	23:00	Coolnabacky site night time	35	50	23	45
1	16-Jul	19:00	Coolnabacky site evening time	39	34	29	37
1	16/17 July	23:00	Coolnabacky site night time	40	32	25	37
1	17-Jul	07:00	Coolnabacky site day time	48	40	34	46

Table 12.4 Noise Measurements at Coolnabacky

Proposed Ballyragget Substation: The measured noise level at Ballyragget substation was 58 dBA during the day and 48 dBA during the night. Noise levels at night are considerably higher than the substation location at Coolnabacky due to its proximity to roads and a large industrial site in the area.

				dB(A)			
Site	**Date**	**Time**	**Location**	**L_{10}**	**L_{50}**	**L_{90}**	**L_{Aeq}**
2	27-Jun	13:59	Roadside R426	61	43	33	62
3	27-Jun	14:25	Cremorgan	42	33	30	50
4	27-Jun	14:57	Raheenduff	52	38	33	56
5	27-Jun	15:30	Clarabaracam	51	40	35	52
6	27-Jun	16:15	Keelagh	40	36	33	38
7	28-Jun	18:03	Knockardagur	44	39	34	41
8	28-Jun	17:41	Boleybawn	47	45	44	46
9	27-Jun	16:54	Ironsmills	54	41	38	61
10	28-Jun	16:52	Loughall	58	51	46	54
11	27-Jun	17:38	Ballyoskill	40	36	34	51
12	28-Jun	16:11	Tinnaltan	60	54	49	56
13	27-Jun	18:09	Ballyragget s/stn	54	43	40	59
14	28-Jun	00:12	Ballyragget s/stn (night time)	45	40	39	48
15	28-Jun	09:44	Ballyragget s/stn	59	45	41	58
16	28-Jun	15:46	Ballyragget s/stn	55	49	46	58
17	28-Jun	15:08	Castlecomer road	65	51	46	67
18	28-Jun	14:30	Connahy	54	48	42	54
19	28-Jun	13:59	Foulksrath	46	41	37	46

Site	Date	Time	Location	dB(A)			
				L_{10}	L_{50}	L_{90}	L_{Aeq}
20	28-Jun	13:29	Inchakill Glebe	40	37	34	55
21	28-Jun	13:01	Bullock Hill	49	45	41	49
22	28-Jun	12:28	Radestown	47	40	36	43
23	28-Jun	11:57	Brownstown	60	42	39	57
24	28-Jun	11:28	Templemartin	57	46	42	59
25	28-Jun	11:00	Kilkenny s/stn	79	59	49	73

Table 12.5 Noise measurements Coolnabacky - Ballyragget - Kilkenny

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing.

- L_{Aeq} is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period.
- L_{90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for 'quiet period' background noise.
- L_{50} is the sound level that is exceeded for 50% of the sample period. It is typically used as a descriptor for 'steady state' background noise.
- L_{10} is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for the traffic related component of noise.

12.7.4 POTENTIAL IMPACT

12.7.4.1Do Nothing Impact

A 'Do Nothing' impact on the project would result in similar noise levels which exist at the proposed sites, which can be seen in Table 12.2 and Table 12.3. In a 'Do Nothing' situation, there would be no change to the existing environment.

12.7.4.2 Construction Noise - Substations & Cable Trench

At the proposed substation sites the main impacts of on-site construction will be associated with noise from plant and construction traffic. The largest items of equipment used on the site will be excavators and dozers for site clearance and a crane for installation of the transformers. Rock breaking, piling, earthmoving and concreting tend to be the noisiest activities during construction. Other noise sources will include construction traffic, probably comprising a small number of private cars and vans and occasional truck traffic to deliver material. During construction, diesel generators are also likely to be used on-site. The impact on overall traffic levels and traffic noise levels on the road network will be minimal. Table 12.6 below indicates the source noise level and typical numbers of equipment on site. The actual noise levels will depend on equipment duty cycles and site activity at any stage during construction.

Description	Purpose	Notes	L_w (dB)	Approx. No
Earth moving Dozer	Site clearance	Diesel Engine Powered	108	1
Tracked Excavator	Site works	Diesel Engine Powered	105	2-3
Pile driver	Foundations	Diesel Engine Powered	115	1
Rock-breaker	Break up top layers and fractured rock	Diesel Engine Powered	115	1
Crawler Crane	Lifting plant, materials and equipment into	Heavy Plant. Tracked.	105	1-2

	position. Two may be required for some heavy plant	Diesel engine powered		
Dumper Truck	Transport of material on site	Typically wheeled (6 wheel drive) Diesel engine powered.	117	1-2
Concrete Truck	Mixing, transport of concrete to site and placement.	Diesel engine powered	109	2-3
Compressors & pumps	General construction purposes,	Mobile, diesel engine powered enclosed and silenced	95	2
Generator	Provide electricity in for equipment, hand tools and site lighting during construction.	Diesel engine powered enclosed and silenced	97	1
Concrete mixer	Mixing of concrete on site	Diesel engine powered	105	1-2
Trucks, vans, 4x4 vehicles	Transport of materials & personnel	Generally diesel powered	101	3-10
Hand tools	Cutting, fixing, welding and general construction	Generally 110kV powered by Generator	102	4

L_{wA} = sound power of plant items

Table 12.6 Levels of Typical Common Sounds on the dB(A) Scale

Construction activity on the site will comprise the traditional construction techniques of concrete work, block-laying, carpentry and roofing, followed by equipment installation. None of these activities are of themselves significantly noisy. Construction of substations will be of modest scale and not dissimilar to the construction of a farm-yard with reinforced concrete construction. Typical activities will comprise site clearance and foundations, concrete pouring, building construction, site perimeter security fence etc. Specialist construction techniques will comprise the bringing onto site of some heavy equipment and the erection of specialist electrical equipment such as pylons, switchgear etc. which will require the use of large cranes.

The installation of polesets, towers and of the cable trenches at Coolnabacky and Ballyragget will require the use of excavators and potentially cranes and trucks for short periods. At Coolnabacky, cable trenches will be dug approximately 1.3 km away from the public road. At Ballyragget, these activities will be carried out on the R432 roadway adjacent to the existing site. The use of such equipment will give rise to elevated noise levels on a localised basis. Due to the varied and constantly changing nature of construction noise emissions, it is proposed to control construction noise by limiting the emissions.

The only guidelines for construction related noise (in Ireland) are those published by the National Roads Authority in Table 3 of their Guidelines for the Treatment of Noise and Vibration in National Roads Schemes. These guidelines are as follows:

Days & Times	$L_{Aeq\ (1hr)}$ dB	$L_{pA(max)slow}$ dB
Monday to Friday 07:00 to 19:00hrs	70	80[2]
Monday to Friday 19:00 to 22:00hrs	60[2]	65[2]
Saturday 08:00 to 16:30hrs	65	75
Sundays and Bank Holidays 08:00 to 16:30hrs	60[2]	65[2]

Table 12.7 Maximum permissible noise levels at the façade of dwellings during construction

Construction activities will be in compliance with NRA guidelines noise levels. In particular any possibility of local disturbance will be limited by restricting any noisy activities to daytime hours (7.00 - 19.00 hrs). Therefore because of the temporary nature of construction works and limits on hours of working, noise is not expected to give rise to significant impacts.

On completion of construction of the new substation at Ballyragget (Unit 4), the existing 38kV substation on the site will be decommissioned and dismantled. Noise levels at residential buildings are not expected to exceed the NRA value of 70 dB(A) at noise sensitive properties as a result of these works.

12.7.4.3 Construction Noise - Overhead Lines

During erection of the lines, there may be additional noise similar in nature to when work on the substation is being carried out. The overall noise level will be less than that at the substation construction however, since such activities are confined to daylight hours and are for a short duration these temporary increases in noise levels are generally acceptable.

Construction equipment to erect polesets and towers involves excavators, wheeled and tracked dumpers, concrete trucks, vans and 4x4 vehicles. This level of equipment and activity is similar to a road repair crew or a construction crew on an agricultural building. The activity is spread out along the length of the 110kV line and the impact on any location is limited to a few weeks duration for angle mast construction locations and generally a half day for poleset erection. Full details of the construction effort required during the OHL construction phase can be found in Construction Methodology Report which accompanies this application.

12.7.4.4 Operational Noise - Substations

There are no published guidelines for operational noise limits in Ireland. In practice, noise limits for industrial activities are often specified having regard to the principles contained in the EPA Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4). The usual range of values allowed for industrial activities is 40 – 45 dB(A) at night and 50 – 55 dB(A) during the day, at the nearest residence or at the boundary of the premises.

Electrical substations are not inherently noisy locations, as they do not generally contain noise generating machinery or equipment. Noise sources for consideration include transformers, electrical cables and switching equipment and occasional traffic moving to and from the site.

Once the substations have been commissioned, noise will continue to be emitted by much of the equipment in the station such as switchgear (circuit breakers and disconnects). Many of the noises associated with this equipment are typically of short duration and individually they would be unlikely to cause significant annoyance. The proposal for both substations (Coolnabacky and Ballyragget) is to use GIS type switchgear which is considerably quieter in operation than the current equipment at Ballyragget. The existing equipment at Ballyragget is open to the atmosphere and of an older generation of design.

The existing noise levels are outlined in Table 12.5. Gas Insulated Switchgear (GIS) is fully enclosed and will not increase existing noise emission levels.

The transformer can be a significant noise source in a transmission station; again newer equipment is not as noisy as previous generations of equipment. Modern transformers are typically 20 dB quieter than equivalent models manufactured in the 1980's and work continues to increase efficiency and reduce noise related losses in transformers.

Transformer noise takes the form of a low frequency hum that can be tonal in nature and lead to annoyance. Noise from electrical overhead conductors is generally confined to locations where the conductor is attached to a substation or a support using isolators. When the isolators break down or under adverse weather conditions, there can be a voltage leakage leading to noise.

A power transformer emits noise from three main sources:

- Its tap-changer, whose noise level may be high but because of its infrequent operation does not constitute a noise issue.
- Its cooling fans, whose noise levels may be considerable but covers fairly broad frequency spectrums and is usually of limited duration. It is likely that the cooling fans will only be used at times of peak load during the day.
- The transformer core - the noise associated with the transformer core is the result of electrical and magnetic forces associated with the application of voltage and the flow of electric power, acting on the components of the structure. It is primarily due to what is called magneto-striction of the core laminations, i.e. they are extended for each of the two magnetisations per cycle so that the fundamental frequency of the noise is 100 Hz.

ESB specifications require that the noise level of a transformer, including all cooling fans, measured according to IEC60551, shall not exceed 70dB(A) at 2m from the transformer. Based on this value the sound pressure level (Lp), due to the transformer alone, is estimated to be less than 30dB(A) at a distance of approximately 150 metres from the transformer. Given the distances from the proposed substations to the nearest dwellings (Table 12.3), significant noise impacts are not likely to occur.

Proposed Coolnabacky Substation (Unit 1):
A noise prediction model was undertaken for the proposed 110kV/400kV Coolnabacky substation. The noise prediction model chosen was constructed using Bruel & Kjaer "Predictor" Package. The Predictor software package is a comprehensive acoustic modelling system and is widely used to predict noise impacts.
The program calculates the received noise level from specified sources, propagated via intermediate obstacles and media, based on national and international standards. Consequences of noise reduction measures can be rapidly assessed and it is possible to compare calculated, measured and permitted values.

Model data is held in a database of the Predictor model. The types of items in a model include ground contours, sound sources, objects and sound receivers. Each item has positional information, including its location, dimensions on the ground and height. The base area is superimposed upon a 2-D topographical map, the background which is used to align each item in the model relative to an actual survey of the area under study. Using the height detail from the model specifics a 3-D terrain model is created.

Models can be prepared for different times of day and calculated to predict the sound pressure levels at the receiver points. The calculation for the model is done with a specific calculation method, in this case ISO 9613.1/2 (Acoustics – Attenuation of sound during propagation outdoors).

The terrain in the baseline noise model is based on mapping provided from ESB International.

Noise Model Calculation Standards

The ISO calculation method is implemented in Predictor as separate source related modules. The primary noise source in the substation will be transformer noise. Noise from switchgear will be minimal as the equipment is Gas Insulated and located inside the sub-station building. External line breakers are only operated occasionally and are not inherently noisy in operation. The ISO 9613-1/2 industry calculation methodology has been adopted for this prediction. This is an appropriate methodology and is widely used for industrial noise calculations internationally.

The following standards are used in the ISO industry calculation method:

- ISO 9613-1 Acoustics – Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere;
- ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors. Part 2: General method of calculation.

The Sound Power Levels of the sources used to create the model are derived from data provided by ESB International and measurements taken by Biospheric Engineering Ltd. at various sub-stations. The model is based on 2 transformers at the sub-station. The sound power levels used to model the transformers were as follows:

Frequency Hz	31	63	125	250	500	1k	2k	4k	8k	Total
LwA dB	36	60	90	83	86	70	59	56	53	92

Table 12.8 Maximum permissible noise levels at the façade of dwellings during construction

Figure 12.2 shows the noise model contours predicted for the site. The modelled noise contours for the substation site are as follows.

Figure 12.2 Operational Noise Model

The contours on the map indicate the predicted noise levels emanating from the sub-station. The green (outer) line indicates the predicted 23 dBA contour. At this point and inside the line, the predicted transformer noise is equal to the background (L90) noise level recorded on the site at night. The yellow contour represents the predicted 29 dBA contour corresponding to the evening time background noise level. The orange contour indicates the predicted 34 dBA contour which is the corresponding measured day time noise level. The red contour in the centre represents the 45 dBA contour line which is the area in the immediate vicinity of the substation.

As can be seen from the noise prediction map above the worst case operating noise prediction will result in noise levels above 45 dBA confined to an area in the immediate vicinity of the proposed sub-station. Due to the low background noise levels in the immediate area of the sub-station, the transformers will be audible outside the sub-station boundary area under certain weather conditions only (indicated by the

outer green line in Figure 12.2). Weather conditions which would increase audibility are calm still conditions or with a very light breeze blowing in the direction of the receiver, such as on a frosty night. The area in which the transformers are likely to be audible does not include any residences. Residences in the area are generally located along the road network and background noise measurements at these locations are considerably higher than at the sub-station site, providing sufficient masking for any noise emanating from the sub-station.

12.7.4.5 Operational Noise - Overhead Lines

There are three types of noise generated by power lines, namely gap sparking, corona noise and Aeolian noise that can be produced by power lines under certain wind conditions. A further form of wind induced noise arises due to turbulence, but this is characteristic of all structures including trees, is broadband in nature and generally is not considered a nuisance. The noise values calculated by ESBI have been performed using the methodology described in the Electric Power Research Institute (EPRI) AC Transmission Line Reference Book – 200kV and Above, (Third Edition 2005).

12.7.4.5.1 Gap Sparking

Gap sparking can develop at any time on power lines at any voltage. It occurs at tiny electrical separations (gaps) that develop between mechanically connected metal parts. Combinations of factors, such as corrosion, vibration, wind and weather forces, mis-fabrication, poor design or insufficient maintenance, contribute to gap formation. Gap sparking can give rise to electrical noise, i.e. frequencies higher than those that are audible to humans, including frequencies used for radio and television signals. Gap sparking can be a problem even at quite large distances from power lines. However, it is monitored on the network and is easily identified and readily solved.

12.7.4.5.2 Corona Noise

Corona occurs when the potential of a conductor in air is raised to such a value that the voltage stress at the surface of the conductor is greater than the dielectric strength of the air surrounding it. In the region where the corona appears, the air is electrically ionised and becomes a conductor of electricity. A discharge of pale violet colour appears near the adjacent metal surfaces and is accompanied by a hissing sound. Corona noise is generally associated with very high voltage overhead lines, i.e. 400 kV and above. It is extremely rare on 110kV lines, to the extent that it is usually measured under laboratory conditions rather than the external environment.

Corona discharge causes noise over a wide range of frequencies that can be either audible or electrical. Corona noise differs from most commonly encountered noise in that it contains a relatively greater proportion of energy at the higher audio frequencies. Figure 12.3 and Figure 12.4 *Corona Noise Level* shows the worst case conductor L_{50} audible corona noise levels as a function of lateral distance from the centre of the line. Table 12.7 summarises the peak values for 110 and 400kV OHL's. Generally noise level values at fifty metres from the line are less than ambient background noise level. Based on background noise measurements taken along the line route, corona noise it is not expected to give rise to complaints.

The level of audible corona at any time is dependent on the prevailing weather conditions. Corona noise is more prominent during heavy rain, when large numbers of corona sources form at water droplets on the conductors. However, on such occasions the background noise due to rainfall and wind tend to mask the noise from the line. Noise is likely to be more noticeable during periods of light rain, snow or fog when persons are likely to be indoors or to have windows closed, and when the background noise is generally lower. In fair weather, corona sources are sufficiently few in number that this noise is generally of no concern and is often inaudible to people on the ground.

General design principles minimise corona discharge noise from overhead lines. On a properly designed line, as in the case of ESB lines, corona noise rarely results in complaints of interference to radio or television signals, except perhaps in weak signal fringe areas.

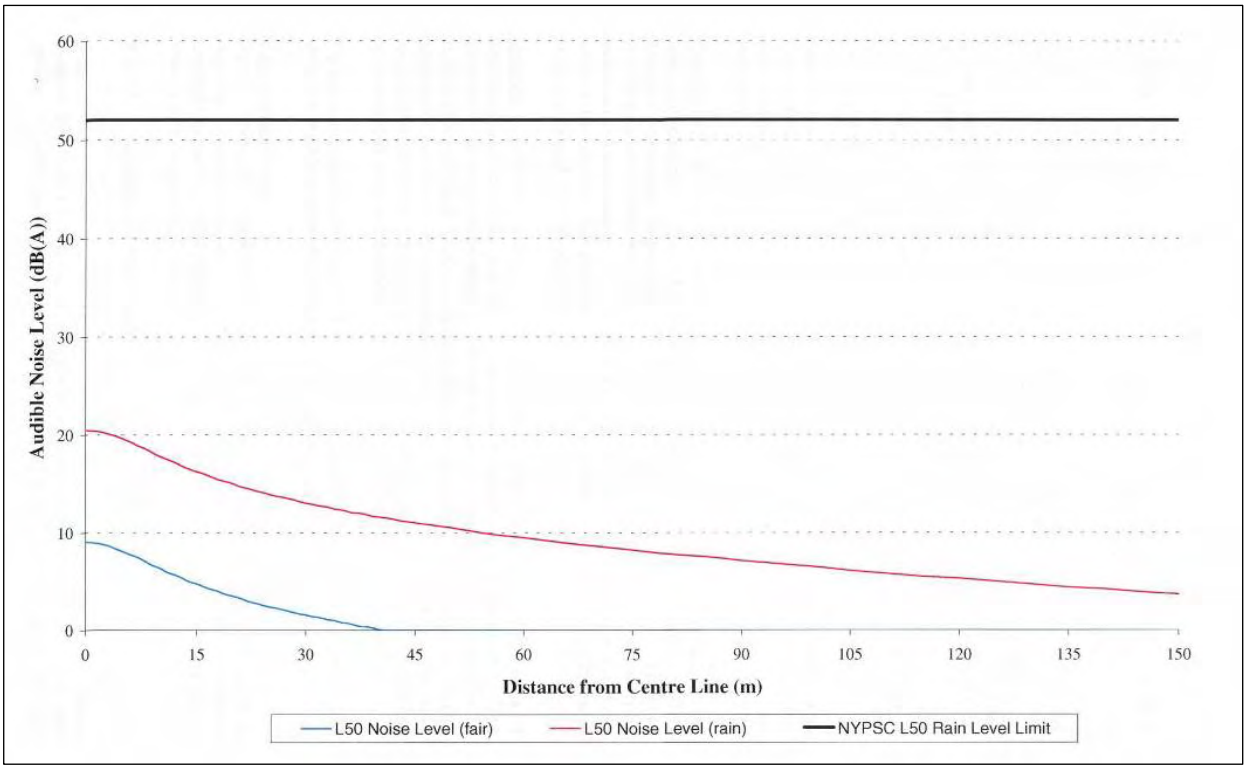

Figure 12.3 Corona Noise Level for a 400kV Line

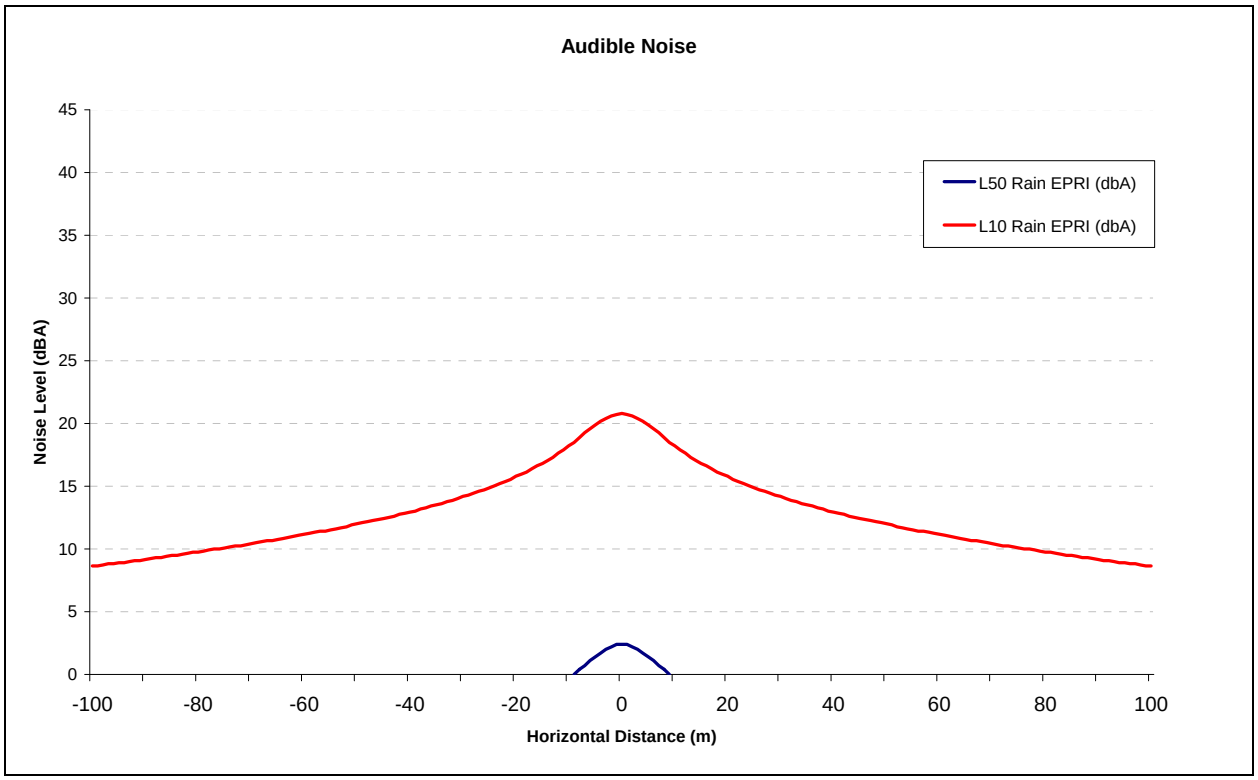

Figure 12.4 Corona Noise Level for 110kV Line

12.7.4.5.3 Aeolian Noise

Aeolian noise occurs under well-defined wind conditions and is caused by wind impinging on the components of a line. Its level and frequency are determined by wind speed and direction and occurrence is not dependent on the line being energised. The noise can be tonal in nature but is generally dominant in the 50 - 250 Hz low frequency range. It arises uncommonly, since the required conditions are very specific, although in particular localities it may occur more frequently. Additionally, because the human ear is relatively insensitive to low frequencies, in practice it is not generally a problem.

Aeolian Noise occurs under well-defined wind conditions and is caused by the wind impinging on the different components of a line, e.g. conductors and insulators. The two meteorological factors that affect the level and frequency of this noise are the wind speed and direction. The different line components give rise to different types of noise. The noise is not dependent on whether or not the line is energised. The occurrence of Aeolian noise is uncommon, since the conditions under which the noise occurs are very specific.

The various line components, i.e. steel towers, conductors and insulators, give rise to different types of noise. While Aeolian noise may occasionally occur when wind blows through a steel tower, noise that is sometimes produced under rather specific conditions by the wind blowing over conductors and insulators is generally of greater importance.

Conductors: The regular shedding of air vortices as the wind flows across the conductor causes the noise. At wind speeds of below approximately 10m/s (force 6) a “swishing” noise may occur, but at a low level that is seldom troublesome. At higher wind speeds, the noise is similar to the “rumbling” sound of aircraft flying overhead in the distance. Complaints may arise due to this type of noise but it can usually be reduced, for example by ensuring that the shedding of air vortices is irregular through the use of air flow spoilers.

Insulators: This noise occurs for only specific high wind speeds and angles of incidence and only for certain designs and arrangements of insulators. Its occurrence may be difficult to anticipate, but it is usually possible to reduce or eliminate it by ensuring that sufficient acoustic resonance does not occur. In practice, this means replacing some units in the insulator string with units having a different rib profile. This noise occurs quite infrequently and if it does occur ESB is committed to carrying out appropriate mitigation measures.

12.7.4.6Potential Decommissioning Impacts

The decommissioning phase will be similar to the construction phase. Decommissioning would be carried out over a short period of time, with localised elevated noise levels.

12.7.4.7Cumulative Impacts

There are currently no other known permitted developments in the vicinity of the proposed development that could contribute to cumulative impacts.

12.7.5 MITIGATION MEASURES

12.7.5.1 Construction Phase - Substations

Noise during the construction stage will be limited by the scale of the project. The noise levels will be maintained within the limits set in National Roads Authority guidelines (the only ‘official’ construction noise guideline in Ireland). The construction stage contract will include provision for independent noise monitoring to ensure that noise limits are being adhered to.

12.7.5.2 Operational Phase - Substations

Landscaping and planting of trees and shrubs at the sites will reduce visual impacts and perceived noise levels.

It is not expected that audible noise generated from within the substations will cause annoyance, as outlined previously. The landscaping and screening around the substation site will further help to reduce the noise level.

Following commissioning of the substations, a noise assessment will be carried out to ensure that noise levels emanating from the substation do not exceed 45 dB(A) L_{Aeq} (15 minutes) at night and 55 dB(A) L_{Aeq} (1 hour) during the day at any noise-sensitive location. In the event that there is a significant tonal content in the noise, the limits will be reduced by 5 dB(A).

12.7.5.3 Operational Phase - Overhead lines

As outlined in the previous sections, it is not expected that noise arising from corona will give rise to complaints. Corona noise, if present, will be audible only under certain weather conditions and in close proximity to the line.

Aeolian noise very rarely occurs on overhead lines and is not expected to arise on the proposed lines. As outlined earlier, mitigation measures for Aeolian noise include the fitting of air-flow spoilers on conductors and the replacement of disc insulators.

12.7.6 RESIDUAL IMPACTS

Overall the predicted noise impact from the development will be low and is not expected to give rise to complaints from local residents.

12.7.6.1 Construction Phase

During the construction phase of the project there will be some small short term impact on nearby residential properties due to noise emissions from site traffic and other activities. However, given that the construction phase of the development is temporary in nature, it is expected that the various noise sources will not be excessively intrusive. Furthermore, the application of binding noise limits and hours of operation, along with implementation of appropriate noise and vibration control measures, will ensure that noise and vibration impact is kept to a minimum.

Construction noise will be within the limits set out in the National Roads Authority Guidance on construction noise and will not have significant impact at the nearest dwellings.

12.7.6.2 Operational Phase

The proposed substation development is not expected to have any noticeable noise impact on the surrounding environment. The noise emissions from the development are significantly shielded by the proposed enclosures around the noisiest items of plant. As a result the predicted noise levels associated with the mechanical plant and building services are within the recommended criteria and the resultant noise impact is small and not significant. It is expected that noise generated by the transformer will be sufficiently attenuated outside the substation so as not to cause annoyance at neighbouring properties. In addition, the noise level should be further reduced by landscaping and the planting of the earthen berms around the substation perimeter.

During operation, noise from within the substation due to switch gear and alarms are not foreseen to be a problem, as any such noise would be infrequent and of short duration.

Corona noise is not expected to give rise to complaints for the Laois-Kilkenny Project. Aeolian noise rarely occurs on overhead lines and in the unlikely event of it occurring, appropriate mitigation measures will be applied.

12.8 INTERRELATIONSHIPS BETWEEN ENVIRONMENTAL FACTORS

This section should be read in conjunction with Section 5 *Human Beings and Population* for a full understanding of the main interactions between these environmental topics.

Section 11 *Material Assets* considers traffic generated by the project (relates to noise and emissions).