ANNEX B

Baseline Air Quality & Dust Monitoring Report

CLIENT: Dalradian Gold

PROJECT: Curraghinalt Project, Proposed Gold Mine.

Baseline Air Quality Monitoring Report.

Prepared by: Envest

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1 Introduction

Envest was commissioned on behalf of Dalradian Gold Ltd. (DGL) to complete a baseline air quality monitoring survey for the proposed Curraghinalt Project in County Tyrone, Northern Ireland.

The Curraghinalt deposit and associated infrastructure are located within an area comprising a topographic ridge that forms the drainage divide between the Owenkillew River and the Owenreagh River. It is understood that the project has the following components:

- An underground mine;
- A decline, a sloping shaft/ tunnel that will be developed as the main access to the mineral deposit, it will extend from a portal at surface and near to the mineral process plant;
- An existing adit, a horizontal passage that provides access to the mineral deposit, originally developed for exploration of the deposit that will be retained to provide initial access for mine development and secondary/safety access to the mine workings in the operational phase;
- Three ventilation raises that will be used to ventilate the mine workings, one of these exists having been developed as part of the underground exploration programme;
- A mineral processing plant;
- A Dry Stack Facility (DSF) for storage of dry stack tailings and uneconomic rock – this facility will contain some of the flotation tailings from the plant, after they have been dewatered (85% of water removed) by means of a filtration process, and uneconomic rock from development of the mine workings;
- Paste backfill placed in the mine workings, this cement bound material will provide support in the workings and will be derived from tailings from the plant, specifically some of tailings from the flotation process and all of the tailings from the cyanide leaching process, mixed with binders;
- Ancillary infrastructure and services required to support the activities (administrative buildings, mobile maintenance shop, warehouse facilities, chemical and explosive stores, a mine dry, parking, site roads, water supply, water treatment and telecommunications);
- Connections, to offsite infrastructure including the Northern Ireland road network and the electrical grid;
- Passing bays on the Camcosy Road developed for the underground exploration programme and to be retained for the mine development.

A detailed Project Description has been prepared by SRK Consulting.

This Baseline Air Quality Monitoring Report has been presented as an Annex to the Air Quality Impact Assessment for the Curraghinalt Project.

2 Statutory Consultees Comments

In order to assist in defining the scope of Air Quality baseline monitoring and impact assessment, Envest consulted with the following individuals and statutory bodies;

- [redacted] and [redacted] of the Fermanagh & Omagh District Council (FODC) Environmental Health Department (EHD);
- [redacted] and [redacted] of the Northern Ireland Environment Agency (NIEA) Industrial Pollution and Radiochemical Inspectorate (IPRI)[1]; and
- [redacted] and [redacted] of the Department for Infrastructure (DfI), Strategic Planning Division, which was formerly within the Department of Environment (DoE).

In response to the Pre-Application Discussion (PAD) (LA10/2016/0030/PAD), the Department of Environment compiled a letter dated 26th February 2016 that presented the following comments from NIEA IPRI in relation to dust and air quality:

The Inspectorate recommends that baseline dust deposition and air quality surveys are undertaken during different seasons to account for any variations in weather (ideally over 12 months). The Inspectorate requires the following meteorological data: wind direction and speed, temperature and rainfall to be recorded to coincide with the dust deposition and air quality survey data. The meteorological station should be located in a representative location.

The Inspectorate recommends that the dust and air quality management and monitoring plan is included as part of the site protection plan.

The above comments were coupled with the following note about a Pollution Prevention and Control (PPC) permit, which DGL will have to obtain for listed activities:

Informative

A PPC Permit issued under The Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013 (PPC Regulations) covers the activities listed in Schedule 1 of the PPC Regulations. From review of the scoping document these are likely to include:

[1] NIEA IPRI is a management unit within the Northern Ireland Environmental Agency (NIEA). Following recent government restructuring, the NIEA has transferred from the former Department of Environment (DOE) to the Department of Agriculture, Environment & Rural Affairs (DAERA).

Site Activities	***Schedule in PPC Regulation 2013***	***Description of Schedule in PPC Regulations 2013***
Crushing and Screening Activities	*Section 3.5 Part B(a)*	*Unless falling within Part A of any section in this Schedule, the crushing, grinding or other size reduction, screening or heating of any designated mineral or mineral product except where the operation of the activity is unlikely result in the release into the air of particulate matter.*
Carbon-in-leach / Carbon strip	*Section 2.2 Part A(a)*	*Producing non-ferrous metals form ore, concentrates or secondary raw materials by metallurgical, chemical or electrolytic activities.*
Electrowinning	*Section 2.2 Part A(a)*	*Producing non-ferrous metals form ore concentrates or secondary raw materials by metallurgical, chemical or electrolytic activities.*
Smelting using a furnace (details to be confirmed by the operator during discussions regarding the PPC application process)	*Section 2.2 Part C*	*Melting, including making alloys of non-ferrous metals (other than tin or any alloy which in molten form contains 50 percent or more by weight of tin), including recovered products (refining, foundry casting, etc.) in plant with a melting capacity of 4 tonnes or less per day for lead or cadmium or 20 tonnes or less per day for all other metals and where the designed holding capacity of molten metal is less than 0.5 tonnes (together with any additional refining).*
Use of cement in backfill paste	*Section 3.1 Part B(a)*	*Blending cement in bulk or using cement in bulk other than at a construction site, including the bagging of cement and cement mixtures, the batching of ready mixed concrete and the manufacture of concrete blocks and other cement products where the activity is not related to an activity described in paragraph (a) of Part A of this section and is carried on at the same location as an activity described in Paragraph (a) of Part B of Section 3.5*

NIEA IPRI will permit and control dust and air pollutant emissions from the Part A and Part B processes of the proposed Curraghinalt Project in accordance with the Integrated Pollution Prevention and Control (IPPC) Guidance such as:

- Horizontal guidance for environmental assessment and appraisal of Best Available Techniques (BAT);
- Mining waste operations: additional guidance (Environment Agency) February 2011.

Other potential dust and air quality pollutant sources from the Curraghinalt Project prescribed as Part C activities under the Pollution Prevention and Control (Industrial Emissions Regulations (Northern Ireland) 2013 will be under the jurisdiction of FODC.

NIEA IPRI and FODC EHD will refer to Planning Practice Guidance 'Assessing Environmental Impacts from Mineral Extraction – Dust and Air Quality' (March 2014) when reviewing the planning application. Other relevant guidance includes the Local Air Quality Management Technical Guidance (LAQM.TG16) published in April 2016. This technical guidance (LAQM.TG16) supersedes all previous versions, the most recent being LAQM.TG09. It is designed to support local authorities in carrying out their duties under the Environment Act 1995, the Environment (Northern Ireland) Order 2002, and subsequent regulations. Local Air Quality Management (LAQM) is the statutory process by which local authorities monitor, assess and take action to improve local air quality.

In correspondence dated 18th March 2016, FODC EHD stated that '*Dust monitoring should be carried out in accordance with best available practices'* and that '*The consultancy is advised to make contact with the EHD or IPRI as appropriate, in advance of undertaking noise/dust monitoring, to discuss monitoring locations, duration and parameters selected'*.

On 18th April 2016, a meeting was held with representatives of FODC EHD, NIEA IPRI and DfI at the DGL office in Omagh to provide a detailed project description of the Curraghinalt Project, discuss matters raised by NIEA IPRI and FODC EHD and to introduce and discuss the baseline air quality and dust monitoring. A field visit to the proposed infrastructure site and existing baseline monitoring locations in the surrounding area was also undertaken. The importance of providing comprehensive long-term baseline studies was agreed and monitoring location selection was discussed in detail with various recommendations proposed by the statutory consultees. The relevance of specific guidance documents and standards was also discussed. The record of correspondence and meeting minutes are attached in Annex A.

3 Relevant Legislation, Standards & Guidelines

3.1 Relevant Legislation

Industrial Emissions	• Pollution Prevention And Control (Industrial Emissions) Regulations (Northern Ireland) 2013 (SR 160) • Pollution Prevention (Industrial Emissions) (Amendment) Regulations (Northern Ireland) 2014 (SR 304)
Industrial Emissions Directive	• Directive 2010/75/EU of the European Parliament and the Council on industrial emissions is the main EU instrument regulating pollutant emissions from industrial installations. It recasts seven previously existing directives, including the Integrated Pollution Prevention and Control (IPPC) Directive and directives concerning large combustion plants, waste incineration, solvent emissions and waste from the titanium dioxide industry. The 2013/160 Regulations transpose Directive 2010/75/EU
Air Quality Standards	• Air Quality Standards Regulations (Northern Ireland) 2010 (SR 2010/188)

3.2 The Air Quality Standard Regulations (Northern Ireland) 2010

The Air Quality Standards Regulations (Northern Ireland) 2010 (SR 2010/188) came into operation on 11th June 2010. Schedules 2, 3, 4, 5 and 6 of the Regulations outline limit values, target levels, objectives, information and alert thresholds and critical levels for the protection of vegetation for various pollutants including sulphur dioxide (SO_2), nitrogen dioxide (NO_2), benzene (C_6H_6), carbon monoxide (CO), Lead (Pb), particulates including PM_{10} & $PM_{2.5}$, arsenic (As), cadmium (Cd), nickel (Ni) and benzo(a)pyrene ($C_{20}H_{12}$), Ozone (O_3) and oxides of nitrogen (NO_x).

The measured sulphur dioxide (SO_2), nitrogen dioxide (NO_2), benzene (C_6H_6), particulates including PM_{10} & $PM_{2.5}$, arsenic (As), cadmium (Cd), nickel (Ni) and oxides of nitrogen (NO_x) background concentrations have been compared with the relevant values outlined in The Air Quality Standards Regulations (Northern Ireland) 2010 as presented in Table 1.

Table 1: The Air Quality Standards Regulations (Northern Ireland) 2010

SCHEDULE 2 Limit values
Regulation 18(1) and (2)

Sulphur dioxide

Averaging period	*Limit value*
One hour	350 µg/m^3 not to be exceeded more than 24 times a calendar year
One day	125 µg/m^3 not to be exceeded more than 3 times a calendar year

Nitrogen dioxide

Averaging period	*Limit value*
One hour	200 µg/m^3 not to be exceeded more than 18 times a calendar year
Calendar year	40 µg/m^3

Benzene

Averaging period	*Limit value*
Calendar year	5 µg/m^3

Carbon monoxide

Averaging period	*Limit value*
Maximum daily eight hour mean**(1)**	10 mg/m^3

(1) The maximum daily eight hour mean concentration of carbon monoxide shall be selected by examining eight hour running averages, calculated from hourly data and updated each hour. Each eight hour average so calculated will be assigned to the day on which it ends, i.e. the first calculation period for any one day will be the period from 17.00 on the previous day to 01.00 on that day, the last calculation period for any one day will be the period from 16.00 to 24.00 on that day.

Lead

Averaging period	*Limit value*
Calendar year	0.5 µg/m^3

PM_{10}

Averaging period	*Limit value*
One day	50 µg/m^3 not to be exceeded more than 35 times a calendar year
Calendar year	40 µg/m^3

$PM_{2.5}$

Averaging period	*Limit value*	*Margin of tolerance*	*Date by which limit value is to be met*
Calendar year	25 µg/m^3	20% on 11 June 2008, decreasing on the next 1 January and every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2015	1 January 2015

SCHEDULE 3 Target values
Regulation 19(1)
Arsenic, cadmium, nickel and benzo(a)pyrene

Pollutant	*Target value for the total content in the PM_{10} fraction averaged over a calendar year*	*Date by which target value should be met*
Arsenic	6 ng/m^3	31st December 2012
Cadmium	5 ng/m^3	31st December 2012
Nickel	20 ng/m^3	31st December 2012
Benzo(a)pyrene	1 ng/m^3	31st December 2012

Ozone

Objective	*Averaging period*	*Target value*
Protection of human health	Maximum daily eight hour mean(1)	120 µg/m^3 not to be exceeded on more than 25 days per calendar year averaged over three years(2)
Protection of vegetation	May to July	AOT 40 (calculated from 1h values) 18,000 µg/m^3.h averaged over five years(2)

(1) The maximum daily eight-hour mean concentration shall be selected by examining eight-hour running averages, calculated from hourly data and updated each hour. Each eight-hour average so calculated shall be assigned to the day on which it ends, that is, the first calculation period for any one day will be the period from 17.00 hours on the previous day to 01.00 hours on that day, the last calculation period for any one day will be the period from 16.00 hours to 24.00 hours on the day.

(2) If the three or five year averages cannot be determined on the basis of a full and consecutive set of annual data, the minimum annual data required for checking compliance with the target values will be valid data for one year in relation to the target value for the protection of human health and valid data for three years in relation to the target value for the protection of vegetation.

$PM_{2.5}$

Averaging period	*Target value*
Calendar year	25 µg/m^3

SCHEDULE 4 Long term objectives for ozone
Regulation 9(2) and Regulation 21(1)

Objective	*Averaging period*	*Long term objective*	*Date by which long term objective should be met*
Protection of human health	Maximum daily eight hour mean within a calendar year	120 µg/m^3	Not defined
Protection of vegetation	May to July	AOT 40 (calculated from 1h values) 6000 µg/m^3.h.	Not defined

SCHEDULE 5 Information and alert thresholds
Regulation 22
Alert thresholds for Sulphur dioxide and Nitrogen dioxide

Pollutant	*Alert threshold*[1]
Sulphur dioxide	500 µg/m^3
Nitrogen dioxide	400 µg/m^3

(1) To be measured over three consecutive hours at locations representative of air quality over the least 100 km^2 or an entire zone, whichever is smaller.

Information and alert thresholds for Ozone

Purpose	*Averaging period*	*Threshold*
Information	1 hour	180 µg/m^3
Alert	1 hour	240 µg/m^3

SCHEDULE 6 Critical levels for the protection of vegetation
Regulation 23
Critical levels for the protection of vegetation

Averaging period	*Critical level*
Sulphur dioxide: Calendar year and winter (1 October to 31 March)	20 µg/m^3
Oxides of nitrogen: Calendar year	30 µg/m^3 NO_x

3.3 Dust Deposition Guidelines

Dust particles can be classified into those that are easily deposited and those that remain suspended in the air for long periods. This division is useful as deposited dust is usually the coarse fraction of particulates that causes dust annoyance, whereas suspended particulate matter is implicated more in exposure impacts. Airborne particles have a large range of diameters, from nano-particles and ultrafine particles (diameters less than 0.1µm) to the very large particles with diameters up towards 100µm. There is no clear dividing line between the sizes of suspended particulates and deposited particulates, although particles with diameters >50 µm tend to be deposited quickly and particles of diameter <10 µm (PM_{10}) have an extremely low deposition rate in comparison. Therefore, the size of suspended and deposited dust particles affects their distribution and as such requires two very different approaches to sampling these fractions. PM_{10} is the fraction of airborne (suspended) particulates which contains particles of diameter less than 10µm. $PM_{2.5}$ is the fraction of airborne (suspended) particulates which contains particles of diameter less than 2.5µm. PM_{10} and $PM_{2.5}$ particles can penetrate deep into the respiratory system increasing the risk of respiratory and cardiovascular disorders. Total Suspended Particles (TSP) is the term used when referring to larger particles which do not have a specified size limit. It is common for TSP to be measured alongside PM_{10} and $PM_{2.5}$ particularly at industrial sites when dust monitoring is undertaken.

Particulate matter can emanate from natural and anthropogenic sources. Natural sources include sea salt, forest fires, pollen and moulds. Natural sources are unregulated and harder to control. Anthropogenic sources can be regulated and understanding the sources of particulate matter is very important. PM_{10} is most commonly associated with road dust and construction activities. Wear and tear of brakes and tyres on vehicles and crushing activities at construction sites can all contribute to a rise in PM_{10}. $PM_{2.5}$ is associated with fuel burning, industrial combustion processes and vehicle emissions. Larger particles (100µm diameter) are likely to settle within 5-10m of their source under a typical mean wind speed of 4-5 m/s, and particles between 30-100 µm diameter are likely to settle within 100m of the source. Smaller particles, particularly those <10 µm in diameter, i.e. PM_{10}, have a greater potential to have their settling rate impeded by atmospheric turbulence and to be transported further from their source. Dust emissions are exacerbated by dry weather and high wind speeds. The impact of dust therefore, also depends on the wind direction and the relative location of the dust source and receptor.

Currently no UK statutory standards or limits exist for the assessment of dust deposition and its tendency for causing nuisance. Similarly, no official air quality criterion has been set at a European or World Health Organisation (WHO) level, although a range of national 'yardstick' criteria from other countries is found in the literature.

In England and Wales, a *'custom and practice'* limit of 200 mg/m^2/day is sometimes referenced using Frisbee-type Deposition Gauges. This value was derived by multiplying a historical, typical UK median background by 3.5 (which was the ratio of the 95th percentile to the median). It should be noted that because background dust levels can vary significantly from place to place and with season, the authors were clear that the preferred approach is to calculate a bespoke site-specific "complaints likely" dust guideline, where sufficient local baseline monitoring data are available (at least 12-months) based on 3.5 times the median background level. However, such bespoke local baseline data are often not available and in such cases the authors recommended using as a fall-back the 95th percentile of typical UK background data. It is important that the limitations of the 200 mg/m^2/day benchmark are appreciated: firstly, it is simply a custom and practice yardstick and it was never based on actual dose-response data; secondly, in deriving this default "complaints likely" guideline, the authors Vallack & Shillito used a dataset that was quite old and not necessarily indicative of today's background levels.

The German TA Luft Regulations, "Technical Instructions on Air Quality Control" state that total dust deposition (soluble and insoluble, measured using Bergerhoff type dust deposit gauges as per German Standard Method for determination of dust deposition rate, VDI 2119) should not exceed a dust deposition rate of 350 mg/m^2/day (when averaged over a 30+/-2 day period). The use of this limit value is appropriate to minimise the impact of airborne dust levels on the

receiving environment beyond the site boundary. The German TA Luft criteria for '*possible nuisance'* and *'very likely nuisance'* are 350mg/m^2/day and 650mg/m^2/day, respectively.

Criteria from other countries that can be referred include;

- In the USA, Washington has set a state standard of 187mg/m^2/day for residential areas.
- Western Australia also sets a two-stage standard, with '*loss of amenity first perceived'* at 133 mg/m^2/day and '*unacceptable reduction in air quality*' at 333mg/m^2/day.
- The Swedish limits promoted by the Stockholm Environment Institute, and used regularly in Scotland, range from 140mg/m^2/day for rural areas to 260mg/m^2/day for town centres.

These go some way to addressing the view that the annoyance impact (and hence potential for complaints) depends on the worsening of dust levels above existing background levels.

In 2005, the UK Highways Agency released an Interim Advice Note 61/05 '*Guidance for Undertaking Environmental Assessment of Air Quality for Sensitive Ecosystems in Internationally Designated Nature Conservation Sites and SSSIs*' as a supplement to the Design Manual for Roads and Bridges (DMRB) Guidelines. This interim guidance states that dust or particles falling onto plants can physically smother the leaves affecting photosynthesis, respiration and transpiration. The literature suggests that the most sensitive species appear to be affected by dust deposition at levels above 1,000 mg/m^2/day which is considerably greater than the level at which most dust deposition may start to cause a perceptible nuisance to humans. As such, once dust deposition rates are maintained within the standard guideline for human nuisance (350 mg/m^2/day) the impact of construction dust on sensitive ecosystems is considered negligible.

Therefore, the following dust limits have been used in the assessment of measured levels;

- Dust Deposition Rate limit = 350 mg/m^2/day (averaged over a 30+/-2 day period).
- Dust Deposition Rate limit affecting sensitive ecological receptors = 1,000 mg/m^2/day
- PM_{10} 24 Hour Mean concentration limit = 50 µg/m^3 not to be exceeded more than 35 times a calendar year
- PM_{10} Annual Mean concentration limit = 40 µg/m^3
- $PM_{2.5}$ Annual Mean concentration limit = 25 µg/m^3

3.4 Metal Deposition Guidelines

The German TA Luft Air Quality Standard also specifies deposition limit values for certain trace metals and their inorganic compounds.

Table 2: German TA Luft Air Quality Standard deposition limit values for certain trace metals and their inorganic compounds.

Parameter	Averaging Period	Air Quality Standard
Arsenic and inorganic compounds of arsenic (as As)	1 year	4 µg/m^2/day
Cadmium and inorganic compounds of cadmium (as Cd)	1 year	2 µg/m^2/day
Lead and inorganic compounds of lead (as Pb)	1 year	100 µg/m^2/day
Mercury and inorganic compounds of Mercury (as Hg)	1 year	1 µg/m^2/day
Nickel and inorganic compounds of nickel (as Ni)	1 year	15 µg/m^2/day
Thallium and inorganic compounds of thallium (as Tl)	1 year	2 µg/m^2/day

3.5 Planning Practice Guidance 'Assessing Environmental Impacts from Mineral Extraction – Dust and Air Quality' (March 2014)

The Planning Practice Guidance 'Assessing Environmental Impacts from Mineral Extraction – Dust outlines five key stages to a dust assessment study, as follows:

1. Establish baseline conditions of the existing dust climate around the site of the proposed operations;
2. Identify site activities that could lead to dust emission without mitigation;
3. Identify site parameters which may increase potential impacts from dust;
4. Recommend mitigation measures, including modification of site design; and
5. Make proposals to monitor and report dust emissions to ensure compliance with appropriate environmental standards and to enable an effective response to complaints.

The relevant stages of the dust assessment study are described as follows;

Stage 1: Establish existing baseline conditions:

Existing ambient conditions should be recorded over a period sufficient to identify seasonal variations in the range of existing conditions which naturally exist (ideally by a dust-monitoring programme). The assessment should take into account the principal existing dust sources (other than the site) such as air pollution from urban and industrial areas, existing mineral operations, agricultural activities and construction activities.

The location of residential areas, schools and other dust-sensitive land uses should be identified in relation to the site, as well as proposed or likely sources of dust emission from within the site.

The assessment should explain how topography may affect the emission and dispersal of site dust, particularly the influence of areas of woodland, downwind or adjacent to the site boundary, and of valley or hill formations in altering local wind patterns.

The assessment should explain how climate is likely to influence patterns of dispersal by analysing data from the UK Meteorological Office or other recognised agencies on wind conditions, local rainfall and ground moisture conditions.

Stage 2: Identify site activities that could lead to dust emission without mitigation:
Potential dust sources should be identified and their potential to emit dust assessed with respect to the duration of the activity or the potential of dust to become airborne.

Stage 3: Identify site parameters which may increase potential impacts from dust:
This brings together information collected in Stages 1 and 2 with information on sensitive land uses around the site in order to understand how these uses could be affected by dust. Computer modelling techniques can be used to understand how dust could disperse from a site. Alternatively, a more qualitative approach, relying on professional judgement, could be used to bring together the data collected in Stages 1 and 2.

Stage 4: Recommend mitigation measures and site design modifications:
Measures to control dust should be specified and described in terms of their potential to reduce dust and consequent impacts.

This guidance states that additional dust control measures might be necessary to control fine particulates (PM_{10}) to address any impacts of dust might be necessary if, within a site, the actual source of emission (e.g. the haul roads, crushers, stockpiles etc.) is in close proximity to any residential property or other sensitive use. The guidance recommends that operators should follow the assessment framework for considering the impacts of PM_{10} from a proposed site.

The Planning Practice Guidance 'Assessing Environmental Impacts from Mineral Extraction – Air Quality outlines the following:

- Why should planning be concerned about air quality?
- What is the role of Local Plans with regard to air quality?
- Are air quality concerns relevant to neighbourhood planning?
- What information is available about air quality?

- When could air quality be relevant to a planning decision?
- Where to start if bringing forward a proposal where air quality could be a concern?
- How detailed does an air quality assessment need to be?
- How can an impact on air quality be mitigated?

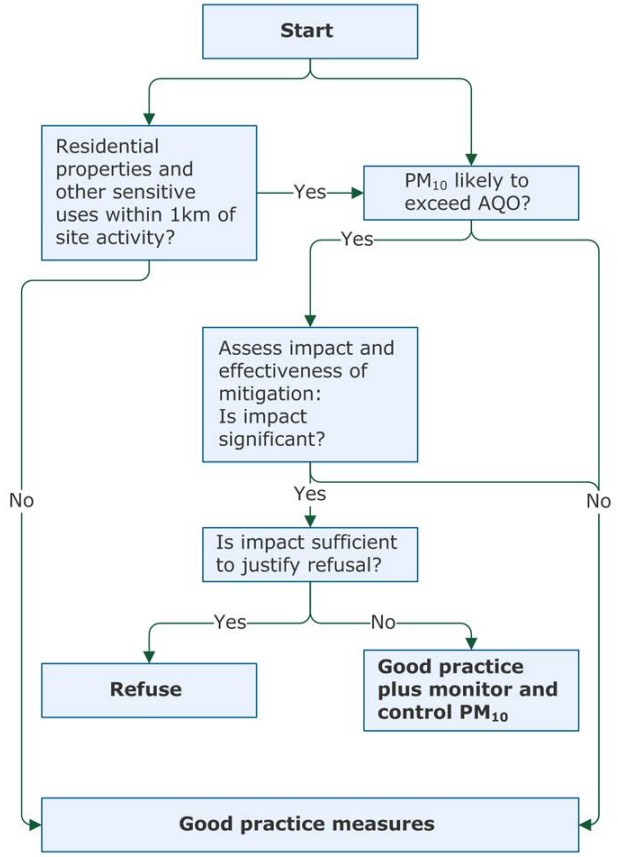
The guidance states that the assessments should be proportionate to the nature and scale of development proposed and the level of concern about air quality, and that the scope and content of supporting information is therefore best discussed and agreed between the local planning authority and applicant before it is commissioned. Therefore, as outlined above, NIEA IPRI and FODC EHD have been consulted.

The guidance advises that the following should be included in air quality impact assessments:

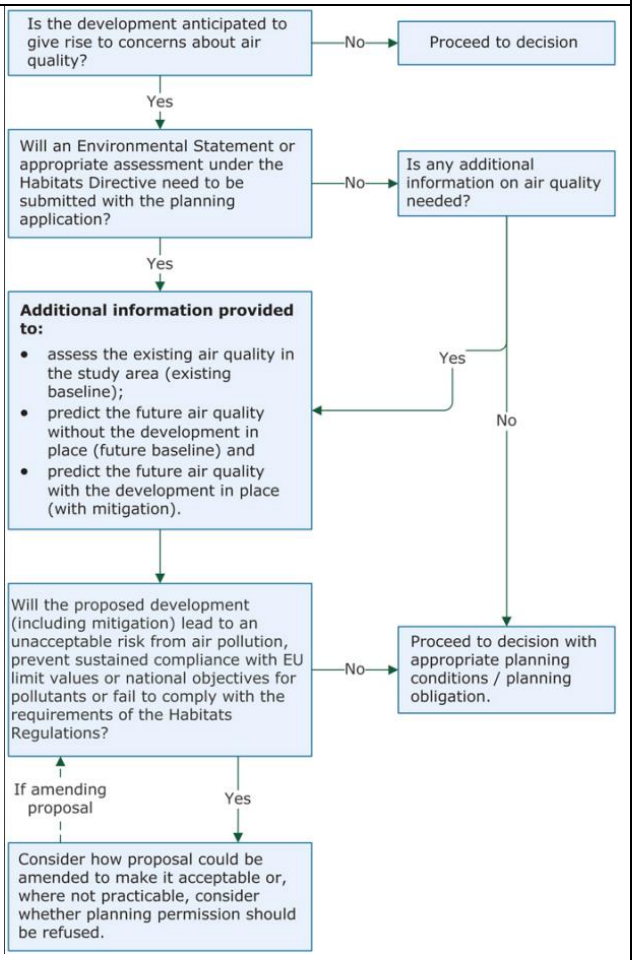
- a description of baseline conditions and how these could change;
- relevant air quality concerns;
- the assessment methods to be adopted and any requirements around verification of modelling air quality;
- sensitive locations;
- the basis for assessing impact and determining the significance of an impact;
- construction phase impact; and/or
- acceptable mitigation measures.

Chart 1: Planning Practice Guidance 'Assessing Environmental Impacts from Mineral Extraction Site Assessment flow charts – Dust and Air Quality.

Dust Assessment flow chart



Air Quality Assessment flow chart



4 Methodology

4.1 Site Selection Criteria

The baseline air quality monitoring surveys were carried out in proximity to representative air quality sensitive residential properties spatially distributed around the proposed Curraghinalt Project to establish the current ambient Air Quality and dust deposition levels for the area.

As it is not normal practise or feasible to undertake Air Quality monitoring surveys at every individual property in proximity to a proposed development, it is necessary to select locations to represent a good geographic spread of air quality measurements in the vicinity of the proposed Curraghinalt Project and to establish a background air pollutant concentration and / or deposition rate variations in the area.

Through the use of an initial drive-by survey of the area, locations in certain areas with similar characteristics and with no apparent differing air pollutant sources were identified. The measurement locations were selected and positioned such that they provided spatially distributed results indicative of the prevailing air quality at sensitive receptors in areas such as in Rousky, along Crockanboy Road, along Greencastle Road, Greencastle Village, along Camcosy Road and in close proximity to the the proposed infrastructure site. Therefore, Air Quality measurements were conducted at a number of locations to establish realistic air pollutant concentration and deposition rate levels and worst case situations in the vicinity of the proposed Curraghinalt Project.

It was determined that the optimum means of achieving these requirements was to conduct long-term air pollutant concentration and dust deposition rate measurements. Long-term continuous air pollutant concentration and dust deposition rate measurements commenced at specifically selected locations in November 2015.

In terms of continuous particulate monitoring for TSP, PM_{10} and $PM_{2.5}$ specific monitoring locations were selected as continuous particulate monitoring equipment requires a permanent power supply. All continuous particulate monitoring, diffusion tube and dust & heavy metal deposition monitoring locations were selected to be in an open location away from overhanging vegetation or buildings, where there was free circulation of air around the monitoring equipment.

4.2 Description of Air Quality Monitoring Locations & Monitoring Parameters

Baseline air quality and dust monitoring studies have been undertaken in the area of the Curraghinalt Project site by SLR Consulting (SLR), Dalradian Gold Ltd. (DGL) and Envest since 2011. The baseline air quality monitoring studies undertaken have included the dust and metal deposition monitoring, continuous particulate matter (TSP, PM_{10}, $PM_{2.5}$ and PM_1) monitoring and passive diffusion tube monitoring.

Baseline air quality and dust monitoring locations since 2011 have been selected based on proximity to existing and proposed DGL activities and site entrances in the area, historically available monitoring data, site security, suitability of access, prevailing meteorological conditions, and a requirement for spatial coverage of the surrounding receiving environment. The following tables and figures identify the selected baseline air quality monitoring sites by SLR, DGL and Envest. Table 3 provides an overview of the air quality monitoring programmes that have been undertaken since 2011 by SLR, DGL and Envest.

Table 3: Overview of the air quality monitoring programmes undertaken for the Curraghinalt Project.

Parties responsible for the monitoring	Locations	Parameters	Frequency	Monitoring Duration	Methodology
SLR	10 locations (D01 to D010)	Dust and heavy metals deposition	Monthly	July 2011 to October 2015	Bergerhoff dust deposition gauges
	4 locations (PT01 to PT04)	Continuous particulate matter (TSP, PM_{10}, $PM_{2.5}$ and PM_1) monitoring	4 short-term monitoring periods of 3 to 5 days	July, Sept and Nov/Dec 2012 and Nov/Dec 2013	Osiris Particulate Monitors
	4 locations (AQ01 to AQ04)	Passive diffusion tube monitoring for NOx, NO_2, SO_2, BTEX and VOC	Monthly	6 monthly periods between April 2012 and October 2013	Passive diffusion tubes
	4 locations (AQ05 to AQ08)			6 monthly periods between July 2012 and October 2013	
DGL	1 location (D-ET01)	Dust and heavy metals deposition	Monthly	Since April 2014	Bergerhoff dust deposition gauges. Dust residue was acid digested and analysed for suite of metals.
	5 locations (D-ET02 to D-ET06)	Dust deposition			
Envest	7 locations (AQML 1 to AQML7)	Dust and heavy metals deposition monitoring.	Monthly	November 2015 – October 2016.	Bergerhoff dust deposition gauges. Dust residue was acid digested and analysed for suite of metals.
	3 locations (AQML 1, AQML 1B and	Continuous particulate	Long-term particulate	October 2015 – October	Osiris Particulate Monitors

Parties responsible for the monitoring	Locations	Parameters	Frequency	Monitoring Duration	Methodology
	AQML 5)	matter (TSP, PM_{10}, $PM_{2.5}$ and PM_1) monitoring	monitoring over 12 month period.	2016	
	7 locations (AQML 1 to AQML7)	Passive diffusion tube monitoring for NOx, NO_2, SO_2, BTEX and VOC	Monthly	October 2015 – October 2016	Passive diffusion tubes

4.2.1 Monitoring Locations & Parameters selected by Envest

Annex III of Directive 2008/50/EC presents criteria that applies regarding the selection of fixed point measurements. The annex describes macroscale siting and microscale siting considerations, both for health and ecosystem protection. Envest has selected monitoring stations such that they provide data on areas representing typical or maximum concentrations that the population in the area is likely to be exposed to, directly or indirectly.

Dust and heavy metals deposition monitoring:

Dust and heavy metals deposition monitoring, continuous particulate matter (TSP, PM_{10}, $PM_{2.5}$ and PM_1) monitoring and passive diffusion tube monitoring has been carried out at seven locations over the period from October 2015 to October 2016 by Envest. A description of the monitoring locations and the monitoring parameters selected by Envest are outlined in Table 4 and Figure 2.

AQML 1 – AQML 5 (& AQML 7) were selected due to their proximity to the nearest representative residential properties to the north, south, east and west of the proposed Curraghinalt Project. These locations allow for a detailed and extensive baseline air quality and dust survey to establish the background levels that currently prevail in the area.

AQML 6 was selected immediately to the north of the Owenkillew River due to the proximity of the adjacent European site, Owenkillew River SAC, to the north of proposed Curraghinalt Project, dust deposition and air emissions from the proposed activities may affect the sensitive habitats in the vicinity of the development. The Owenkillew River SAC has been designated due to the presence of Annex I habitats, '*Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation*' and '*Old sessile oak woods with Ilex and Blechnum in the British Isles*'. The Annex II species that are a primary reason for selection of this site is the Freshwater pearl mussel, *Margaritifera margaritifera.*

Table 4: Dalradian Gold – Air Quality Monitoring Locations

Monitoring Location	Address	Grid Reference	Monitoring Parameters & Dates
AQML 1	216 Crockanboy Rd	257941, 383884 257972, 383916	TSP, PM_{10}, $PM_{2.5}$, Dust Deposition, NOx, NO_2, SO_2 & VOCs (October 2015 – 24th February 2016)
AQML 1(B)	80 Mullydoo Road	258453, 384327	TSP, PM_{10} & $PM_{2.5}$ (From March 2016 to October 2016)
AQML 2	56 Mullydoo Rd	259397, 384003	Dust Deposition, NOx, NO_2, SO_2 & VOCs (from October 2015 to October 2016)
AQML 3	216 Greencastle Road	260083, 385368	Dust Deposition, NOx, NO_2, SO_2 & VOCs (from October 2015 to October 2016)
AQML 4	Opposite 54 Camcosy Road	257885, 386751	Dust Deposition, NOx, NO_2, SO_2 & VOCs (October 2015 – 12th February 2016)
AQML 4(B)	Opposite 54 Camcosy Road	257648, 386522	Dust Deposition, NOx, NO_2, SO_2 & VOCs (from October 2015 to October 2016)
AQML 5	114 Crockanboy Road	255236, 385665 255170, 385655	TSP, PM_{10}, $PM_{2.5}$, Dust Deposition, NOx, NO_2, SO_2 & VOCs (from October 2015 to October 2016)
AQML 6	122 Gorticashel Road	257009, 387403	Dust Deposition, NOx, NO_2, SO_2 & VOCs (from October 2015 to October 2016)
AQML 7	256 Crockanboy Rd	258888, 383107	Dust Deposition, NOx, NO_2, SO_2 & VOCs (From March 2015 to October 2016)

NOTE: AQML 1 and AQML 4 locations have been moved to AQML 1B, AQML 4B and AQML 7 due to project objection and vandalism during the monitoring period.

In February 2016 the dust monitoring location, AQML 4 opposite 54 Camcosy Road, was slightly repositioned to a different location, AQML 4B, due to vandalism. In March 2016 the dust deposition monitoring location, AQML 1 at 216 Crockanboy Road, was also repositioned to a new location, AQML 7 at 256 Crockanboy Road, at the landowner's request.

Envest has also developed an extensive suite of heavy metals for which the deposition rate has been analysed and reported in $mg/m^2/day$. The suite of heavy metals has been decided upon based on reference to the Air Quality Standards Regulations (Northern Ireland), the German TA Luft Regulations, "Technical Instructions on Air Quality Control", the findings of the Geology & Soils baseline studies and previous dust and heavy metal deposition monitoring undertaken in the area by SLR and DGL. In March 2016, the suite of heavy metal analysis was reviewed by Envest and DGL and refined to include Arsenic (As), Cadmium (Cd), Chromium (Cr), Cobalt (Co), Copper (Cu), Lead (Pb), Mercury (Hg), Molybdenum (Mo), Nickel (Ni), Thallium (Tl), Uranium (U), Vanadium (V) and Zinc (Zn).

Table 5: Full suite of heavy metals deposition rate reported in mg/m^2/day by Envest from October 2015 to October 2016.

Parameter	Reporting Format
Aluminium	mg/m^2/day
Arsenic	mg/m^2/day
Barium	mg/m^2/day
Cadmium	mg/m^2/day
Chromium	mg/m^2/day
Cobalt	mg/m^2/day
Copper	mg/m^2/day
Gold	mg/m^2/day
Iron	mg/m^2/day
Lead	mg/m^2/day
Manganese	mg/m^2/day
Mercury	mg/m^2/day
Molybdenum	mg/m^2/day
Nickel	mg/m^2/day
Silver	mg/m^2/day
Thallium	mg/m^2/day
Uranium	mg/m^2/day
Vanadium	mg/m^2/day
Zinc	mg/m^2/day

Continuous particulate matter (TSP, PM_{10}, $PM_{2.5}$ and PM_1) monitoring:

Envest completed continuous particulate monitoring inclusive of TSP, PM_{10}, $PM_{2.5}$ and PM_1, at the strategically positioned locations, AQML 1, AQML 1B and AQML 5, using Turnkey Osiris particle monitors during the period from October 2015 to October 2016 as outlined in Table 3. This was undertaken in accordance with the siting requirements outlined in Annex III of Directive 2008/50/EC regarding the selection of fixed point measurements, power availability and security considerations. In March 2016 the continuous particulate monitoring location, AQML 1 at 216 Crockanboy Road, was repositioned to a new location, AQML 1B at 80 Mullydoo Road.

Passive Diffusion Tube Monitoring (NOx, NO_2, SO_2, TVOC, BTEX):

Diffusion tube monitoring for nitrogen oxides (NOx), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), BTEX and volatile organic compounds (VOC) was undertaken at seven locations from October 2015 to October 2016 by Envest as outlined in Table 3. In February 2016, the Diffusion tube monitoring location, AQML 4 opposite 54 Camcosy Road, was slightly repositioned to a different location, AQML 4B, due to vandalism. In March 2016, the Diffusion tube monitoring location, AQML 1 at 216 Crockanboy Road, was also repositioned to a new location, AQML 7 at 256 Crockanboy Road, at the landowner's request.