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Tables

7. Air Quality

7.1 Introduction

The Öksüt Project has the potential to generate both particulate and gaseous emissions during all phases of the Project lifecycle. This Chapter provides an assessment of Project emissions on ambient air quality and provides an assessment of the greenhouse gases (GHG) generated by the Project. This Chapter also presents the proposed measures aimed at avoiding and mitigating anticipated impacts to ambient air quality, as well as a reference to the management plans that shall ensure that such mitigation measures are appropriately and effectively implemented.

7.1.1 Objectives

The specific objectives of this air quality impact assessment are to:

- Identify the main sources of potential impact to air quality arising from construction, operation and closure phases of the Project;
- Determine, quantitatively and qualitatively, whether air emissions will impact sensitive receptors in the vicinity of Project Area;
- Assess and define mitigation measures for addressing air quality impacts arising from various Project activities;
- Identify long-term management and monitoring measures for air quality;
- Assess the air dispersion modelling results against the Project Standards, which have been defined based on Turkish law and the requirements of EBRD.

7.1.2 Overview of Key Issues and Emission Sources

The key issues in terms of potential impacts to air quality include:

- Dust emissions ($PM_{2.5}$ and PM_{10}) together with their impact on human health and their potential to cause nuisance to those exposed;
- Emissions of potentially polluting gases: sulphur dioxide (SO_2), and oxides of nitrogen (NO_X) and their potential impact on human health;
- Emissions of GHG (principally CO_2).

7.2 Summary of Policy Context

7.2.1 International Standards

EBRD Performance Requirements

The objectives of EBRD PR3 *Resource Efficiency and Pollution Prevention and Control* are to:

- "identify project-related opportunities for energy, water and resource efficiency improvements and waste minimisation;
- adopt the mitigation hierarchy approach to addressing adverse impacts on human health and the environment arising from the resource use and pollution released from the project;
- promote the reduction of project-related greenhouse gas emissions.

PR3 states the requirement for projects to meet the relevant EU substantive environmental standards, where these can be applied at the project level. Projects must also be designed to comply with applicable national law, and will be maintained and operated in accordance with national laws and regulatory requirements. When host country regulations differ from the levels and measures presented in EU requirements or other identified appropriate environmental standards, projects will be expected to meet whichever is more stringent.

7.2.2 International Conventions and Treaties

Turkey is an Annex I Party to the United Nations Framework Convention on Climate Change. In 2012, the "Doha Amendment to the Kyoto Protocol" was adopted which included:

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020;
- A revised list of greenhouse gases (GHG) to be reported on by Parties in the second commitment period.

The EU, its Member States and Iceland have committed to jointly achieve a 20% reduction in their combined greenhouse gas emissions for the period 2013-2020 compared to the level in 1990 or their chosen base year. Turkey has not yet ratified the Doha Amendment.

The 2015 United Nations Climate Change Conference was held in Paris in December 2015 (COP21). The Conference negotiated the Paris Agreement to reduce emissions as part of the method for reducing greenhouse gas.

The EU's contribution to the new agreement was a binding, economy-wide, domestic greenhouse gas emissions reduction target of at least 40% by 2030 compared to 1990.

Turkey is also party to:

- *Vienna Convention on the Protection of the Ozone Layer* (1985);
- *Montreal Protocol on Substances depleting the Ozone Layer* and the relevant amendments ((The London Amendment (1990), The Copenhagen Amendment (1992), The Montreal Amendment (1997), The Beijing Amendment (1999)) to the Protocol (1987);
- *UNECE Convention on Long-Range Transboundary Air Pollution* (1979) and its protocols, which include emission reduction commitments for 2020 expressed as a percentage of 2005 emissions. The ceilings and targets are not yet enforced in Turkey.

7.2.3 European Directives

The applicable European legislation for the Project's air quality assessment includes:

- *Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on Ambient Air Quality and Cleaner Air for Europe;*
- *Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.*

7.2.4 Turkish Legislation

The applicable Turkish air quality legislation for the Project's air quality assessment includes:

- *Turkish National Regulation on Control of Industrial Air Pollution (dated: 03 July 2009, Official Gazette No: 27277);*
- *Regulation on Assessment and Management of Air Quality (dated: 06 June 2008, Official Gazette No: 26898);*
- *Regulation on Control of Exhaust Gas Emission (dated: 30 November 2013, Official Gazette No: 28837).*

7.2.5 Project Standards

The Project Standards in relation to ambient air quality are presented in Table 7-1 which includes applicable European Union and National legislation[1]. Metal pollutant concentration limits[2] for ambient air are presented in Table 7-2. The Project Standard for limits for atmospheric emissions from stationery sources are provided in Table 7-3.

Table 7-1: Project Ambient Air Quality Standards

Pollutant	Time/Averaging Period	Maximum Allowable Limit		
		EU	Turkish	Project Standard
SO_2 (µg/m^3)	Hourly	350	470 (for 2015) 440 (for 2016) 410 (for 2017) 380 (for 2018) 350 (for 2019-2023)	**350**
	24 hour	125	225 (for 2015) 200 (for 2016) 175 (for 2017) 150 (for 2018) 125 (for 2019-2023)	**125**
	Yearly and winter season (Oct 1st – March 31st) (for wildlife and ecosystem)	-	20	**20**
NO_2 (µg/m^3)	Hourly	200	290 (for 2015) 280 (for 2016) 270 (for 2017) 260 (for 2018) 250 (for 2019-2023)	**200**
	Yearly	40	56 (for 2015) 52 (for 2016) 48 (for 2017) 44 (for 2018) 40 (for 2019-2023)	**40**
PM_{10} (µg/m^3)	24 hour	50	90 (for 2015) 80 (for 2016) 70 (for 2017) 60 (for 2018) 50 (for 2019-2023)	**50**
	Yearly	40	56 (for 2015) 52 (for 2016) 48 (for 2017) 44 (for 2018) 40 (for 2019-2023)	**40**
Fine particles (PM2.5, µg/m3)	Yearly	25	-	**25**

[1]*Directive 2008/50/EC* of the European Parliament and of the Council of 21 May 2008 on *Ambient Air Quality and Cleaner Air For Europe and National Regulation.*
Regulation on Control of Industrial Air Pollution (dated: 03 July 2009, Official Gazette No: 27277).
[2] http://ec.europa.eu/environment/air/quality/standards.htm

Pollutant	Time/Averaging Period	Maximum Allowable Limit		
		EU	Turkish	Project Standard
Settled Dust (mg/m^2day)	24 hour	-	390	**200** [1]
Ozone $\mu g/m^3$	Maximum daily 8-hour average in calendar year	120		**120**

[1] Best practice limit for dust deposition, as suggested by Vallack, H. W. & Shillito, D. E. (1998), "Suggested guidelines for deposited ambient dust", Atmospheric Environment, Vol.32, pp.2737-274

Table 7-2: Ambient Air Metal Pollutant Concentration Limits

Parameter	Average Period	Maximum Allowable Limit[1]
Lead (Pb) ($\mu g/m^3$)	1 year	0.5
Arsenic (As) (ng/m^3)	1 year	6
Cadmium (Cd) (ng/m^3)	1 year	5
Nickel (Ni) (ng/m^3)	1 year	20

[1] Heavy metals are maximum allowable limits from the total content of the PM_{10} fraction averaged over one year. Limits are from *Directive 2004/107/EC*

Table 7-3: Limits for Atmospheric Emissions from Stationary Sources

Source	Pollutant	Standard (mg/Nm^3) unless stated otherwise		
		Turkish	EU	Project Standard
Diesel generators[1]	NO_x[2]	-	N/A	**1460**[3] **1,850**[4]
	SO_2	1700		**1700**
	PM	200		**200**
	CO	150		**150**

[1] Typically rated <2MW and below 50MW threshold in EU Directive 2001/80/EC
[2] In the absence of applicable Turkish and EU standards for small-scale generators, the applicable IFC emissions guidelines have been used.
[3] IFC Standard: exhaust bore size diameter [mm] < 400
[4] IFC Standard: exhaust bore size diameter [mm] > or = 400

7.3 Scope and Assessment Methodology

7.3.1 Spatial Scope

The 10 km^2 Study Area (Figure 7-1) covers the Project Area and encompasses the potentially-affected settlements within the social study area: Öksüt, Zile, Gazi, Zile, Sarıca, Tombak, Yazıbaşı, Gömedi, Epçe, Yukarı Develi and Develi. These settlements were identified as having the potential to be affected by air quality impacts from Project construction and operation activities within the EIA Permitted Area and the access road.

Potential impacts caused by construction of the powerline were assessed along the powerline route as part of the national powerline EIA. Part of the powerline route is shown in Figure 7-1, and the entire route is shown in Figure 5-5.

7.3.2 Temporal Scope

The temporal scope of this assessment covers the full life of the Project. Impacts are discussed for the construction, operation and closure phases of the Project, although with regards to air quality no post-mine legacy is anticipated; that is, following mine closure, air quality impacts from vehicles and processing plant will effectively cease.

7.3.3 Methodology

Data Collection

Data for the assessment of the ambient air quality baseline conditions in the study area was collected via literature review and field sampling.

Secondary Data

Ambient air quality measurements around the Project site were carried out during the EIA permitting process and were reported in the Turkish EIA. The air quality parameters measured were determined in compliance with the *Regulation on Control of Industrial Air Pollution*[3]. Monitoring parameters selected to comply with the Regulation[4] were:

- SO_2;
- NO_2;
- PM_{10};
- Settled Dust;
- Lead (Pb), Arsenic (As), Cadmium (Cd), Nickel (Ni).

Sampling locations were selected to include the closest settlement areas (Öksüt, Zile) and the EIA Permitted Area as summarised in Table 7-4 and illustrated in Figure 7-2.

[3] The *Regulation on Control of Industrial Air Pollution* requires the measurement of ambient air quality for pollutants where there is potential for exceedance of stipulated thresholds by the emission of these pollutants resulting from the conduct of Project activities

[4] Table 2, Annex 2 of the *Regulation on Control of Industrial Air Pollution.*

Figure 7-1: Air Quality Study Area

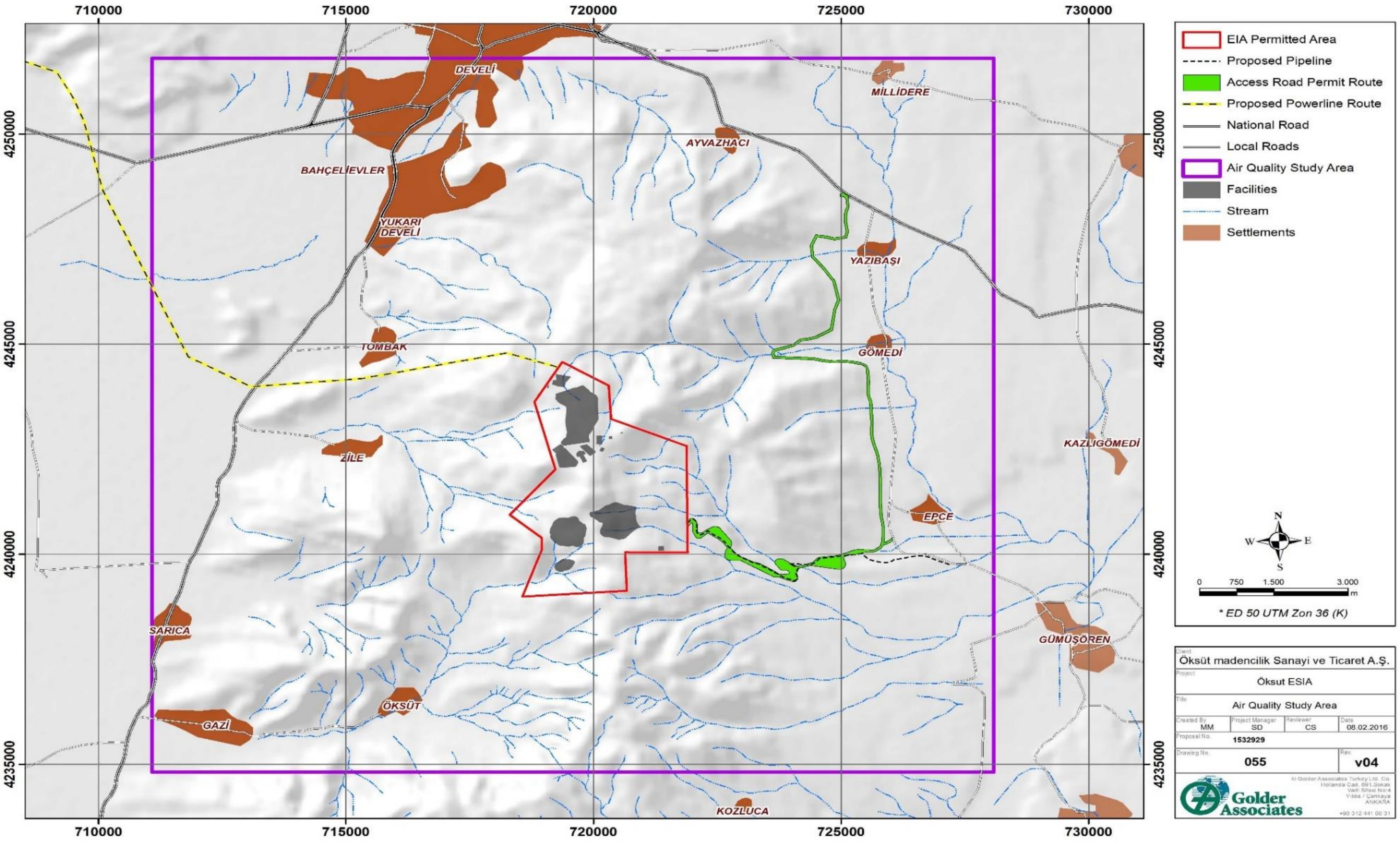


Figure 7-2: Ambient Air Quality Sampling Locations

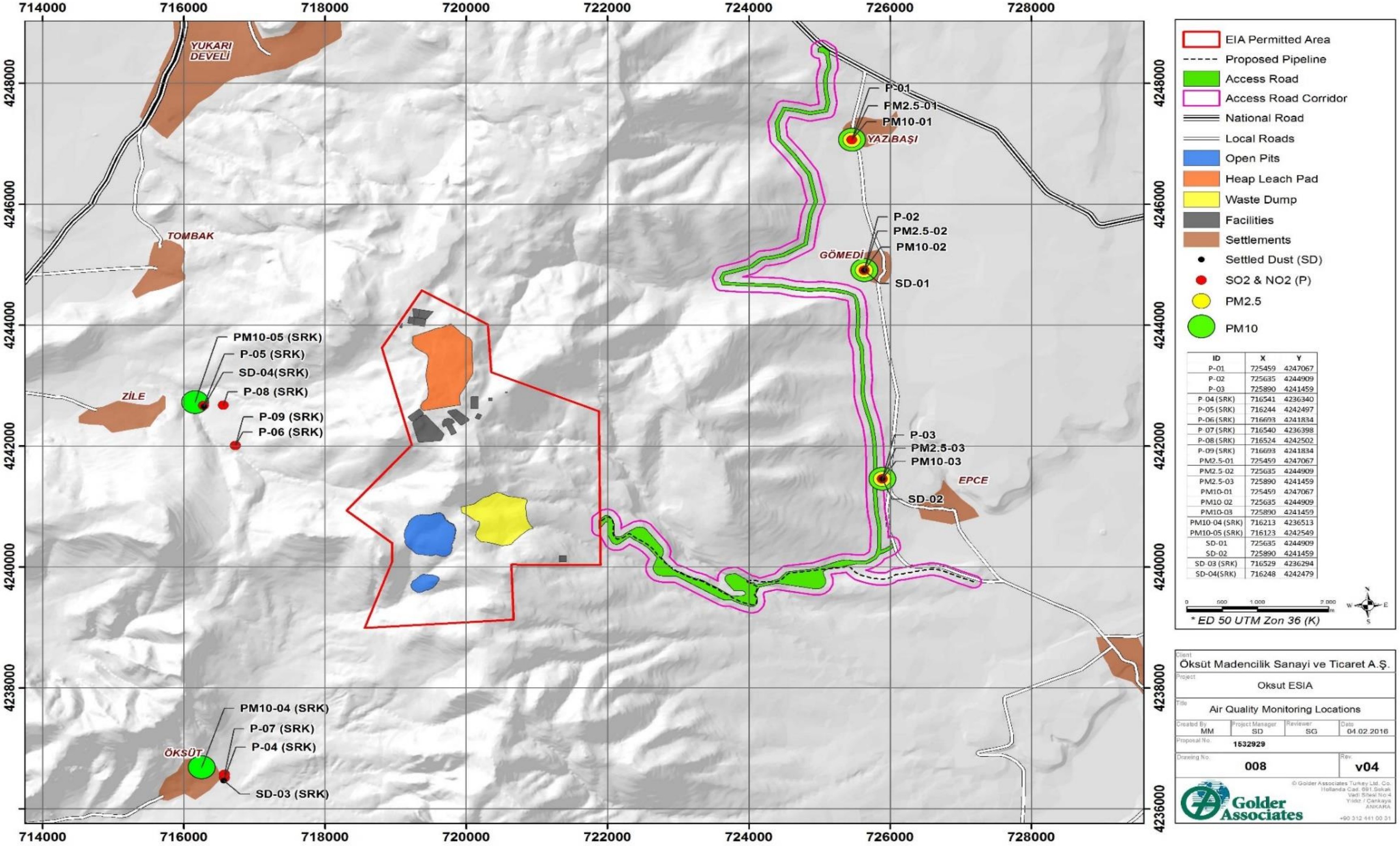


Table 7-4: Sampling Locations for Air Quality Parameters

Location	Parameter
Öksüt	SO_2, NO_2, PM_{10}, Settled Dust, Heavy Metals
Zile	SO_2, NO_2, PM_{10}, Settled Dust, Heavy Metals
EIA Permitted Area	SO_2, NO_2

Additional Baseline Data Collection

An additional field survey was undertaken by Golder on July 14th and 15th 2015 to define the ambient air quality within the access road and water supply pipeline corridor. The objectives of this additional monitoring were to:

- Provide baseline data for air quality, that is consistent with the exiting EIA data, for the extended area that covers the access road and water supply pipeline corridors;
- Provide information on existing air quality parameters that may potentially be impacted by the construction and operation of the access road and water supply pipeline.

Settled dust, SO_2 and NO_2 diffusion tubes monitoring was conducted between July 21st and September 21st 2015. PM_{10} and $PM_{2.5}$ measurements were conducted between July 21st and 22nd 2015.

Baseline data were collected for the following parameters:

- NO_2;
- SO_2;
- PM_{10};
- $PM_{2.5}$.

The sampling locations were selected at the closest receptor (i.e. house or similar) on the boundaries of the relevant settlements. The sampling locations are described in Table 7-5 and illustrated in Figure 7-2.

Table 7-5: Associated Facilities Air Quality Sampling Locations

Measured Parameters	Location Coordinates	Location Name	Location Description
PM_{10} & $PM_{2.5}$ SO_2 & NO_2	36 S 725890 4241459	Yazıbaşı (PO1)	Close to existing road from Yazıbaşı to Epçe at a distance of approximately 10 m; and 200 m to the planned access road.
PM_{10} & $PM_{2.5}$ SO_2 & NO_2 Settled dust	36 S 725635 4344919	Gömedi (PO2)	Junction point of access road with existing public road.
PM_{10} & $PM_{2.5}$ SO_2 & NO_2 Settled dust	36 S 725459 4247067	Epçe (PO3)	Junction of the public road turning towards Epçe.

Powerline Baseline Data Collection

Baseline PM_{10} data was collected as part of the national powerline EIA process. The sensitive receptors closest to powerline construction activity was identified as two residential buildings in Çayırözü, which are ten meters away from tower N01. These two receptors have been used as the worst case scenario for the dust impact assessment.

PM_{10} measurements were collected over a period of 24 hours on 19th November 2015.

Air Quality Modelling

Emissions and dispersion of atmospheric pollutants released by Project activities (excluding construction of the powerline) were simulated by inputting emission sources into the AERMOD (American Meteorological Society/Environmental Protection Agency Regulatory Model) model. A separate AERMOD model simulated the emissions and dispersion of atmospheric pollutants released by blasting. The modelling process is summarised in *Annex G*.

Surface Data (Topography)

Topographic values are crucial for the distribution of emission values. The sensitive points and topography were divided into grids of 500 m x 500 m cells within the 289,000,000 m^2 area (with the dimension of 17,000 m x 17,000 m).

Meteorological Data

A long-term wind rose is presented in Figure 7-3 based on 1960 to 2013 data from the Develi Meteorological Station. Figure 7-4 presents a wind rose for the year 2008 again based on data from the Develi Meteorological Station. It was concluded that the long-term wind rose and the 2008 wind rose are similar with respect to dominant wind directions and wind distribution. On this basis, the 2008 meteorological data was determined to be representative for the wind characteristics of the area and was used in AERMOD.

Meteorological pre-processor software AERMET, which is supported by USEPA (United States Environmental Protection Agency), was used in the preparation of the meteorological data for the AERMOD model. To determine the meteorological data input, quality control of the raw hourly surface data and upper atmosphere data of the relevant year and station was undertaken and the height was calculated. Subsequently, data were combined under a single file and the hourly values were calculated by defining the parameters specific to the site (i.e. surface roughness, albedo rate and bowen rate). Finally, a profile file was prepared according to the compiled surface file, consisting of the standard deviation of wind speed, direction, temperature and wind components at numerous different heights.

The following values were inputted in the AERMET meteorology pre-processor software:

- Hourly surface observations: the values of hourly temperature, wind speed, wind direction, cloud base height and station pressure are the values recorded at Develi Meteorological Station;
- Upper atmosphere observations: the values of atmospheric pressure, elevation from ground level, dry thermometer temperature, wind direction (degree of deviation from N) and wind speed (m/s) are the values recorded at the Adana Meteorological Station (275 km south of the Project Area).

Figure 7-3: Long Term Wind Rose (1960-2013)

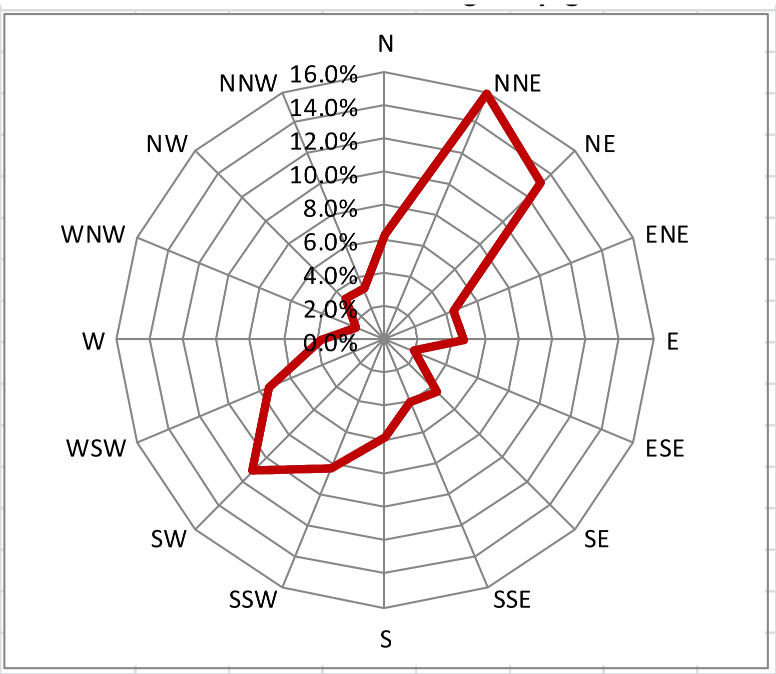
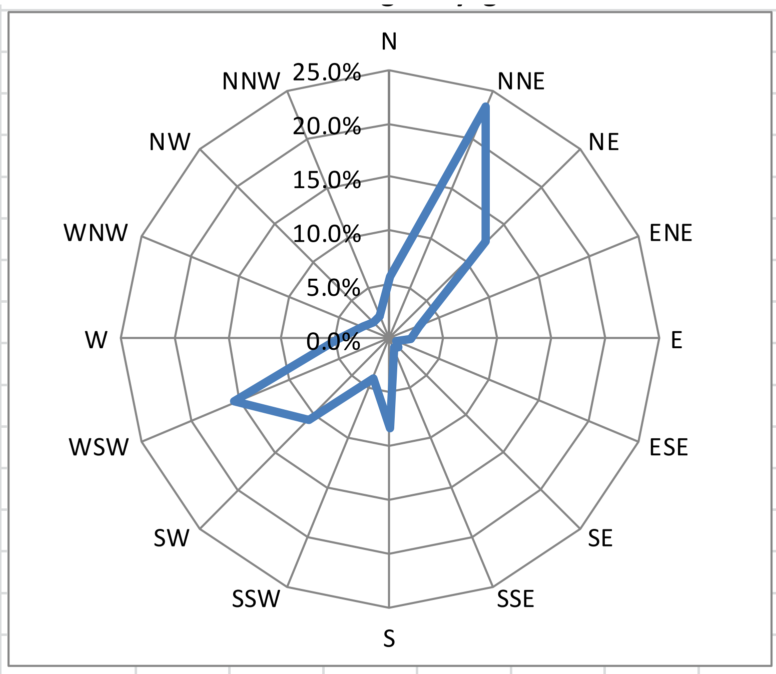


Figure 7-4: 2008 Wind Rose



Modelling Gaseous Emissions

Exhaust emission factors for SO_2 and NO_2 for construction vehicles and machinery were calculated using USEPA coefficients[5], which are presented in Table 7-6 below.

[5] Emission values from vehicles have been sourced from the Exhaust Emission Factors for Non-Road Engine Modelling (Report No. NR-009A) from the United States Environmental Protection Agency (EPA).

Table 7-6: Exhaust Emission Factors

Machinery / Equipment	Engine Power (HP)	Emission Factors (g/hp-hr)	
		SO_2	NO_2
Truck	360	0.8	4.5
Excavator	260	0.8	4.5
Loader	200	0.8	4.5
Grader	200	0.4	4.5
Roller	50	0.8	5.0
Compactor	260	0.8	4.5
Road Paver	225	0.8	4.5

Modelling Dust

The hourly mass flow of dust that will be released during construction and operation was calculated using the following formula:

Dust Emission Volume = Production Tonnage x Emission Factor

This formula was based on the assumptions outlined in *Annex G* to this ESIA and the assumed controlled and uncontrolled dust emission factors presented in Table 7-7.

Table 7-7: Dust Emission Factors

	Uncontrolled*	Controlled**
Excavation Emission Factor (kg/ton)	0.025 kg/ton	0.0125 kg/ton
Loading Emission Factor (kg/ton)	0.010 kg/ton	0.005 kg/ton
Unloading Emission Factor (kg/ton)	0.010 kg/ton	0.005 kg/ton
Transporting Emission Factor (kg/km-trip)	0.7 kg/km-trip	0.35 kg/km-trip

* Emissions while operating at the maximum design capacity and a schedule of 8,760 hours per year.

** Emissions while operating at the maximum design capacity, a schedule of 8,760 hours per year and considering the efficiency of pollution control (e.g. dust suppression measures).

The emission factor of overburden material for uncontrolled open dust sources during blasting was calculated using the following formula[6]:

PM10 (kg/blast) = 0.000114 * $(A)^{1.5}$

A = horizontal area (m^2), with blasting depth # 21 m. Not for vertical face of a bench.

The cumulative effect of PM_{10} and settled dust on receptors was also calculated. PM_{10} was simulated annually and daily separately. Ambient PM_{10} air quality measurements were conducted for 24 hours. The 24-hour PM_{10} measurements were converted to annual values using the methodology presented in the England Environmental Agency Annex-F[7]. Converted measurement results are presented in Table 7-8 and Table 7-9.

[6] AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources

[7] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/298239/geho0410bsil-e-e.pdf

Table 7-8: Converted Concentrations for Road and Water Supply Pipeline Construction

Parameter and Location	Concentration (24-hour, µg/m³)	Concentration (annual, µg/m³)
PM_{10}-1 (Yazıbaşı)	39.117	33.15 ((39.117/0.59)*0.5)
PM_{10}-2 (Gömedi)	19.9	16.8 ((19.9/0.59)*0.5)
PM_{10}-3 (Epçe)	9.89	8.3 ((9.89/0.59)*0.5)

Table 7-9: Converted Concentrations for Construction and Operation of Mine

Parameter and Location	Concentration (24-hour, µg/m³)	Concentration (annual, µg/m³)
SRK Öksüt (µg/m³)	27.5	23.3 ((27.5/0.59)*0.5)
SRK Zile (µg/m³)	24.8	21.01 ((24.8/0.59)*0.5)

7.3.4 Impact Assessment Methodology

Air quality impacts created by Project activities at sensitive receptors are considered when there is an exceedance of any one of the Project Standards. This includes when:

- Emissions from the Project activities are modelled to exceed the limits defined in Table 7-1 to Table 7-3 at identified sensitive receptors.
- The sum of the measured ambient air quality and emissions modelled from Project activities and emissions modelled from blasting exceed the limits defined in Table 7-1 to Table 7-3 at identified sensitive receptors.

7.3.5 Assumptions and Limitations

The following assumptions and limitations were taken into consideration during the air quality modelling:

- The Turkish EIA was used to source the following information:
  - amount of ore and waste rock for Keltepe and Güneytepe open pits;
  - working shifts, working duration in a year and shift numbers during operation;
  - meteorological raw data[8];
  - number of vehicles and equipment for the mine activities;
  - hole depths for the blasting modelling.
- For modelling purposes, it was assumed that the construction of access road and water supply pipeline; and the operation and construction of the mine site will not be overlapped;
- The number of machinery and equipment for the construction of the roads were assumed using expert judgement and based on information on previous construction projects;
- Working shifts and working duration for construction of associated facilities were assumed using expert judgement and based on the legal working hour and night work limitations;
- It was assumed that the amount of excavated material for the construction of associated facilities will be reused on site;

[8] Site meteorological data from OMAS was not used for the modelling study. Meteorological data has been collected for a considerably short period of time (under 2 years) at site, which is not fit for modelling purposes.

- The proposed blasting pattern of Keltepe Open Pit is taken into consideration due to its huge production amount per blasting during assumption of blasting area;
- The blasting area on the open pit was assumed to be 5,950 m^2;
- It is anticipated that the modelling values of blasting from Güneytepe Pit will be lower due to lower production amount. Therefore, the model was run only for Keltepe Open Pit which has larger production amount for illustrating the worst case scenario (assuming only one pit is subject to blasting at any given time);
- The duration for dust emission during blasting is assumed to be 15 minutes;
- The soil density in dust emission calculations was assumed to be 1.6 ton/m^3;
- Any repair and/or maintenance works on road between Gömedi and Epçe was not included into the model;
- The width of the by-pass road was assumed to be 10 m;
- The route of the access road has been updated since the modelling was conducted in September 2015. The modelled access road route did not include the section of road that runs parallel to the public road between Gömedi and the Epçe turning, as the Project was going to use the public road. The addition of the section of road between Gömedi and the Epçe turning will not affect the results of the air quality modelling as the new route is located further from receptors than the route modelled in 2015. As a result, it is not considered that the addition of this section of the road will change the outcomes of the modelling;
- The national powerline EIA was used to source baseline and impact assessment information to inform the effects caused by dust from construction of the powerline.

7.4 Baseline

7.4.1 Climate and Meteorology

The climate of Kayseri province is continental, characterized by cold and wet winters, and hot and dry summers. Precipitation falls as snow in winter and rain in spring. The climate in the region is classified as “semi-arid and cold” according to the Köppen classification system, where, annual mean temperature is less than 18˚C and annual total precipitation is between 200 and 400 mm.

Long term data (covering the years from 1960 to 2013) collected at the nearby Develi Meteorology Station operated by the General Directorate of Meteorology shows:

- The annual mean pressure is 879.4 hPa. The highest pressure is 899.9 hPa and the lowest pressure is 854.8 hPa.
- The annual mean temperature is 11.0˚C. The highest temperature measured is 39.0˚C (in 2000), and the lowest temperature is -22.2˚C (in 1972).
- The annual mean relative humidity is 59.4%.
- The annual mean precipitation is 355.5 mm. The highest daily precipitation amount was recorded as 57.00 mm in the month of December.
- Approximately 29.6 days in a year observe snowfall and approximately 42.6 days are snow-covered. The highest snow depth is 53 cm in February.
- Fog events are observed 6.5 days of a year on average.
- The annual mean number of frost days is 25.5 days.
- The mean annual wind speed is 2.0 m/s. The highest mean wind speeds were recorded in March and April and the lowest mean wind speeds in August, September, October, November, and December. The highest wind speed recorded is 40.2 m/s from the direction of S-SE.

- The dominant wind is from the NNE direction with 15.9% frequency. The second dominant direction is NE with 13.3% and the third dominant direction SW with 11.1% frequency. The wind direction with the lowest frequency is WNW with 1.9%.

7.4.2 Ambient Air Quality

Ambient air quality monitoring results are presented in Table 7-10 and these were compared with the Project Standards (refer Section 7.2.5). The measured ambient air quality levels for the selected parameters do not show any exceedance of Project Standards except for levels of cadmium. As concentrations of cadmium were not exceeded in the soils sampled (see *Annex J: Soil and Land Use*), the elevated concentrations of cadmium in the atmosphere have been attributed to vehicle exhaust emissions in the villages of Öksüt and Zile.

The study area exhibits the characteristics of clean, rural air. Although not exceeding Project Standards, the ambient air quality is quite dusty, with measurements of 127 mg/m^2/day in Öksüt and 122 mg/m^2/day in Epçe. The atmosphere is considered to have a moderate natural resilience to imposed stresses in terms of pollutants. The sensitivity of the receptor is therefore, determined as **medium**.

Table 7-10: Ambient Air Quality Monitoring Results

	Short Term Values (24 hours)	**Long Term Values**								
	µg/m³	**µg/m³**					**ng/m³**	**ng/m³**	**ng/m³**	**µg/m³**
	PM_{10}	**SO_2**	**NO_2**	**PM_{10}**	**$PM_{2,5}$****	**Settled Dust (mg/day.m²)**	**Arsenic (As)**	**Cadmium (Cd)**	**Nickel (Ni)**	**Lead (Pb)**
SRK-Öksüt		2.1	1.3	27.5	-	127	Winter 0 Summer 1.9	Winter 7.9*** Summer 4.8	Winter 1.1 Summer 0	Winter 0.0170 Summer 0.0126
SRK-Zile		2.0	1.6	24.8	-	45	Winter 2.1 Summer 1	Winter 0 Summer 5.8***	Winter 1.7 Summer 0.02	Winter 0.0411 Summer 0.0096
SRK-EIA Permission Area		2.2	1.8	-*	-	-	-	-	-	-
Golder-Yazıbaşı (P-01)	39.117	<1.49 (1st Period) <1.36 (2nd Period)	3.60 (1st Period) 3.90 (2nd Period)		18.691	-	-	-	-	-
Golder-Gömedi (P-02)	19.943	<1.49 (1st Period) <1.36 (2nd Period)	5.65 (1st Period) 3.25 (2nd Period)		15.514	117	-	-	-	-
Golder-Epçe (P-03)	9.891	<1.49 (1st Period) <1.36 (2nd Period)	2.61 (1st Period) 5.98 (2nd Period)		4.636	122	-	-	-	-

	Short Term Values (24 hours)	Long Term Values								
	µg/m³	µg/m³					ng/m³	ng/m³	ng/m³	µg/m³
	PM_{10}	SO_2	NO_2	PM_{10}	$PM_{2,5}$**	Settled Dust (mg/day.m²)	Arsenic (As)	Cadmium (Cd)	Nickel (Ni)	Lead (Pb)
Powerline EIA: Building 1 Çayırözü	16.36	-	-	-	-	-	-	-	-	-
Powerline EIA: Building 2 Çayırözü	19.07	-	-	-	-	-	-	-	-	-
Project Standards	**50**	**20**	**40**	**40**	**25**	**200**	**6**	**5**	**20**	**0.5**

* There was not measurement security; therefore sampling could not be conducted.
** $PM_{2.5}$ measurements are done for 24 hours because of the time limitations on baseline data collection.
*** Limits exceeded.

7.5 Impact Assessment

7.5.1 Introduction

Scoped In

Potential air quality impacts caused by:

- the use of existing tracks from Zile and Yukarı Develi during construction (prior to completion of the access road) are assessed;
- construction of the access road and water supply pipeline are modelled and assessed;
- construction of the powerline, which has the potential to cause dust impacts, and was assessed as part of the national powerline EIA;
- onsite construction and operations activities within the EIA Permitted Area are modelled and assessed. Dust impacts from blasting and potential effects on receptors during operation have been modelled and assessed;
- Closure impacts are considered to be the same as construction.

Scoped Out

Based on the low volumes of projected project traffic (outlined in *Chapter 5: Project Description)* and the materials used to construct the roads (bitumen surface), it is not considered that use of the access road will cause any significant air quality impacts during the operations or closure phases of the mine. Although indirect dust impacts on farmland during construction are not identified as a significant/material risk, mitigations have been included in the Air Emissions Management Plan and Livelihoods Restoration Framework on a precautionary basis.

Emissions of other potentially hazardous species, (e.g. HCN, etc.) and their potential impact on human health are not considered in this impact assessment. Design measures are outlined in the Project Description (*Section 5.18.1*). The detailed design of the cyanide detection system will be developed as part of the detailed design of the HLF. In addition to the cyanide detection system, all persons working in a cyanide area (ADR or Heap Leach) will also wear a personal cyanide monitor that will emit a noise if atmospheric cyanide concentrations above safe levels are detected. Any gas released from the ADR will be below the limit of HCN emission of 5 m/Nm^3 as specified in the *Regulation on Control of Industrial Air Pollution* (for an emission greater than 50 g/s). OMAS will train workers and emergency response personnel to manage cyanide in a safe and environmentally protective manner. Training will include the hazards associated with cyanide use; OMAS procedures and systems; and how to respond to exposure and environmental releases of cyanide.

Construction of the powerline will use two vehicles and the impact from engine emissions is considered to be minimal and has been scoped out of the impact assessment.

Operation of the powerline is also scoped out, as there are no known air quality impacts associated with operation of a powerline.

7.5.2 Emission Sources during Construction of Bypass, Access Road and Water Supply Pipeline

During construction of the access road and water supply pipeline, potential air quality impacts may be caused during surface levelling and grading, stripping and stockpiling of soil material and transport of excavated material. There will be no blasting required during the construction of the offsite roads and water supply pipeline. Emissions of gaseous pollutants, particularly NO_2 and SO_2, will primarily be related to vehicle and machinery exhausts.

Dust Emissions

Airborne dust is typically coarse and therefore remains airborne only for short periods of time. USEPA research shows that in excess of 90% of total airborne dust returns to the earth's surface within 100 m of the release point and over 98% within 250 m.[9]

Construction of the access road and installation of the water supply pipeline is expected temporarily to generate dust as a result of levelling and grading of ground, temporary stockpiling of soils and movement of construction vehicles and machinery on unpaved surfaces.

Table 7-11 presents the total dust emissions during construction of infrastructure, which were calculated using the *USEPA Exhaust Emission Factors for Non-road Engine Modelling* (Report No. NR-009A).

Table 7-11: Total Dust Emissions during construction of access road and water supply pipeline

Process causing dust emissions	Controlled (kg/hour)	Uncontrolled (kg/hour)
Excavation (road around Yazıbaşı and Gömedi)	2	4
Excavation (access road and water supply pipeline)	2.25	4.5
Loading (road around Yazıbaşı and Gömedi)	0.8	1.6
Loading (access road and water supply pipeline)	0.9	1.8
Dust Emission During Unloading (road around Yazıbaşı and Gömedi)	0.8	1.6
Unloading (access road and water supply pipeline)	0.9	1.8
Transportation (road around Yazıbaşı and Gömedi)	2.1	4.2
Transportation (access road and water supply pipeline)	3.35	6.7
Totals:	**13.1**	**26.2**

Exhaust Emissions

Construction machinery and motor vehicles emit pollutants that contribute to ambient concentrations of ozone, PM, NO_2, SO_2 and carbon monoxide. Ground-level ozone pollution is typically formed through reactions involving volatile organic compounds and NO_X in the lower atmosphere in the presence of sunlight. The type and quantity and exhaust emission values for the expected construction machinery and equipment for construction of the roads and pipeline are presented in Table 7-12 below,

Table 7-12: Exhaust Emission Values for Construction Equipment during construction of access road and water supply pipeline

Machinery / Equipment	Number	Engine Power (HP)	Emission (kg/hr)	
			SO_2	NO_2
Truck	6	360	1.7	9.72
Excavator	2	260	0.4	2.34
Loader	1	200	0.16	0.9
Grader	1	200	0.16	0.9

[9] United States Environmental Protection Agent (USEPA) AP-42

Machinery / Equipment	Number	Engine Power (HP)	Emission (kg/hr)	
			SO_2	NO_2
Roller	1	50	0.04	0.25
Compactor	1	260	0.2	1.17
Road Paver	1	225	0.2	1.0
Total			**2.86**	**16.28**

7.5.3 Impacts and Mitigation Measures from Construction of Access Road and Water Supply Pipeline

Dust

The villages of Epçe, Gömedi and Yazıbaşı may be affected by dust from the construction of the access road and installation of the water supply pipeline.

PM_{10}

The maximum modelled PM_{10} emissions were located outside settlements and all modelled emissions were below Project Standards, as presented in Table 7-13 below. Model output figures presenting the diffusion of dust emissions are shown in *Annex H*.

Table 7-13: Maximum PM_{10} Dispersion Modelling Results during Construction of roads and water supply pipeline

Parameter	Location	Controlled (µg/m³)	Uncontrolled (µg/m³)	Project Standard (µg/m³)
PM_{10} Maximum annual emission value	Approximately 200 m to east of Epçe settlement boundary (727081, 4241309)	0.14	0.27	40
PM_{10} Maximum 24 hour average emission value	Approximately 2 km North of Yazıbaşı (724581, 4250309)	1.4	2.7	50

Settled Dust

Modelled settled dust emissions were located outside settlements and were below Project Standards, as presented in Table 7-14 which presents a comparison of maximum settled dust concentration values and the limit values defined by the Project Standards. Model output figures presenting the diffusion of dust emissions are shown in *Annex H*.

Table 7-14: Maximum Settled Dust values during Construction of roads and water supply pipeline

Parameter	Location	Controlled (mg/m²-day)	Uncontrolled ((mg/m²-day)	Project Standard (mg/m²-day)
Settled Dust Maximum concentration	Approximately 2.5 km to west of Epçe. (723081, 4241809)	2.58	4.84	200

Cumulative values of PM_{10}

Modelled results at the background measurement locations (Yazıbaşı, Gömedi and Epçe) and ambient air quality measurement results were assessed cumulatively. The results are all below the Project Standards and are presented in Table 7-15. Model output figures presenting the diffusion of dust emissions are shown in *Annex H*.

Table 7-15: Cumulative Values of PM_{10} and Settled Dust during Construction of roads and water supply pipeline

Location	Scenario		Cumulative Value	Project Standard
Yazıbaşı	Daily PM_{10} (µg/m^3)	Controlled	39.927	50 (µg/m^3)
		Uncontrolled	41.117	
Gömedi		Controlled	20.7	
		Uncontrolled	21.8	
Epçe		Controlled	10.71	
		Uncontrolled	11.69	
Yazıbaşı	Annual PM_{10} (µg/m^3)	Controlled	33.25	40 (µg/m^3)
		Uncontrolled	33.30	
Gömedi		Controlled	16.91	
		Uncontrolled	16.97	
Epçe		Controlled	8.42	
		Uncontrolled	8.49	
SD-1 (mg/m^2-day)	Daily Settled Dust (mg/m^2-day)	Controlled	119.2	200 (mg/m^2-day)
		Uncontrolled	121.1	
SD-2 (mg/m^2-day)		Controlled	123.8	
		Uncontrolled	125.9	

Impact Assessment

Impact	Dust impact on: ▪ Neighbourhoods of Yazıbaşı, Gömedi, Epçe which are close to construction corridor. ▪ Neighbourhoods of Yukarı Develi and Zile, whilst the tracks through these neighbourhoods are used for site access, prior to completion of the access road to the east of the EIA Permitted Area.
Receptor Sensitivity	These settlements are of medium sensitivity.
Impact Magnitude	The impact is expected to be: ▪ Direct as it is a direct result of construction of the access road and supply pipeline; ▪ Of medium-term duration as it may last throughout the construction period; ▪ Localised as it is expected to only spread within the immediate vicinity of the access road and water supply pipeline construction corridors; ▪ Certain to occur due to the nature of construction (i.e. earthworks). The potential impact magnitude is medium, based on modelling results and

	parameters of the impact.
Significance	The effect will be of **minor adverse significance** (i.e. medium receptor sensitivity and medium impact magnitude)

Impact Mitigation

The following mitigation measures are recommended during the construction phase to mitigate dust related impacts:

- Wetting and covering powdery materials transported on trucks;
- Enforcing a speed limit;
- Washing facilities, such as hose-pipes and ample water supply, will be provided at site exits, including mechanical wheel spinners where practicable;
- If necessary, all vehicles will be washed down before exiting the construction site;
- Periodic wetting of the stockpiled material to maintain the humidity percentage at approximately 5%;
- Periodic wetting of the construction areas;
- Adequate maintenance of vehicles, machinery and equipment;
- Provision of compacted granular wearing course material on all graded roads;
- Restriction on vehicular usage in off-road areas and on informal tracks.

A programme will be implemented for monitoring of dust levels at Yukarı Develi, Zile, Yazıbaşı, Gömedi and Epçe during construction to ensure that Project Standards are not exceeded at these receptors.

Residual Effects

The residual effect will be negligible after implementation of mitigation measures.

Gaseous Emissions

The villages of Epçe, Gömedi and Yazıbaşı may potentially be affected the by vehicle SO_2 and NO_2 emissions from the construction of the access road and water supply pipeline.

The maximum modelled emission values were located 4.5 km west of Epçe (coordinates 722081, 4239309) and are presented in Table 7-16. All emission values are below the Project Standards. Model output figures are presented in *Annex H*.

Table 7-16: Maximum NO_2 & SO_2 Concentrations during Construction of roads and water supply pipeline

Parameter		Modelled Result (µg/m^3)	Project Standard (µg/m^3)
NO_2	Hourly	34.8	200
	Annual	0.22	40
SO_2	Daily	0.72	125

Parameter		Modelled Result (µg/m³)	Project Standard (µg/m³)
	Hourly	34.8	350
	Annual	0.03	20

The contribution of background SO_2 and NO_2 measurements to the modelled project emission results was also calculated. SO_2 and NO_2 were simulated annually and daily separately. Ambient SO_2 and NO_2 air quality measurements were conducted for two periods. Modelled results at the baseline measurement locations and ambient air quality measurement results were assessed cumulatively using long term values (annual). The results are presented in Table 7-17 which shows that cumulative values for SO_2 and NO_2 are below Project Standards. Model output graphs presenting the diffusion of SO_2 and NO_2 are presented in *Annex H*.

Table 7-17: Annual Cumulative Values of SO_2 and NO_2

Measurement Location	Cumulative Value* (µg/m³)		Project Standard Limit Values (µg/m³)	
	SO_2	NO_2	SO_2	NO_2
Yazıbaşı	1.51	3.70	20	40
Gömedi	1.506	5.74		
Epçe	1.508	2.71		

*(Long term values + Background measurement)

Impact Assessment

Impact	SO_2 and NO_2 impact on the neighbourhoods of Yazıbaşı, Gömedi, and Epçe; which are close to the construction corridor.
Receptor Sensitivity	These settlements are of medium sensitivity.
Impact Magnitude	The impact is expected to be: ▪ Direct as it is a direct result of construction of the access road and supply pipeline; ▪ Of medium term duration as it may last throughout the construction period; ▪ Localised as it is expected to only spread within the immediate vicinity of the access road and water supply pipeline construction corridors; ▪ Certain to occur. The impact magnitude is defined as medium based on the modelling results and parameters of the impact.
Significance	The effect will be of **minor adverse significance**. (medium receptor sensitivity and medium impact magnitude).

Impact Mitigation

The following mitigation measures are recommended during the construction phase to mitigate air pollutant emissions and dispersion:

- Use of low sulphur content diesel;

- Use and maintain vehicles and equipment in accordance with manufacturer guidelines;
- Replace vehicles and equipment when condition is seen to be deteriorating excessively;
- Implementation of the Grievance Procedure.

A programme will be implemented for monitoring SO_2 and NO_2 levels at Yazıbaşı, Gömedi and Epçe during construction to ensure that Project Standards are not exceeded at these receptors.

Residual Effects

The residual effect will be **negligible** after implementation of mitigation measures.

7.5.4 Impacts and Mitigation Measures from Construction of the Powerline

Construction of the powerline is expected temporarily to generate dust from site preparation and any hole boring activities, temporary stockpiling of soils, wind erosion of disturbed areas and movement of construction vehicles and machinery on unpaved surfaces. As the powerline construction is temporary in nature, impacts are not expected to last for more than 2 days in the same location.

The national powerline EIA assumed that there would be approximately 56 m^3 and 89.6 tons[10] of construction debris for each tower erected. Assuming an excavation duration of 4 hours per tower, it inferred that there is 22.4 tons of excavation debris per hour. Assuming an excavation emissions factor of 0.01 kg per ton of dust emissions, the national powerline EIA assumes a dust generation rate of 0.22 kg dust/hour for each tower. This level of dust generation has not triggered dust emission modelling as per the *Turkish Regulation on the Control of Industrial Air Pollution*.

Impact Assessment

Impact	Dust impact on: ▪ Dwellings which are close to the powerline construction corridor.
Receptor Sensitivity	These settlements are of medium sensitivity.
Impact Magnitude	The impact is expected to be: ▪ Direct as it is a direct result of construction of the powerline; ▪ Of short-term duration as construction of the powerline is transient; ▪ Localised as it is expected to only spread within the immediate vicinity of the towers being constructed; ▪ Likely to occur due to the nature of construction (i.e. earthworks). The potential impact magnitude is low, based on the potential nuisance caused by dust impacts.
Significance	The effect will be of **minor adverse significance** (i.e. medium receptor sensitivity and low impact magnitude)[11]

Impact Mitigation

In addition to the dust mitigation measures outline in Section 7.5.3 above:

- A net cut and fill balance will be aimed for where the soil and rock types allow and stockpiling of material will be avoided.

[10] d=1.6 ton/m^3

[11] The national powerline EIA did not anticipate that there would be a significant effect on sensitive receptors. As a precautionary approach, and because the nearest receptor is 10 m away from one of the towers, OMAS has considered that there is a potential minor adverse significant effect in this instance.

- Unused topsoil will be returned to disturbed areas wherever appropriate.
- Consultation to inform occupants of nearby residential buildings of impending works and duration of works is recommended and has been included as part of the *Stakeholder Engagement Plan*.

Residual Effects

The residual effect will be **negligible** after implementation of mitigation measures.

7.5.5 Emission Sources for Onsite Construction and Operation of the Mine

There is the potential for impacts to ambient air quality during onsite construction and operation of the mine from use of vehicles and machinery, operation of the processing plant and associated facilities such as offices, workshops and accommodation units. The principle impact factors are pollutants and dust releases to the atmosphere.

Dust

During onsite construction and operation of the mine, dust will be generated by excavations within the pits, loading and unloading of haul trucks (ore and waste rock), stockpiling of the mined ore and ore crushing.

Dust emissions values during operation are taken from USEPA guidelines[12] and are presented in Table 7-18.

Table 7-18: Dust Emission Values during Onsite Construction and Operation of the Mine

Source	Controlled (kg/hour)	Uncontrolled (kg/hour)
Excavation of ore	2.36	4.71
Loading of ore	0.89	1.77
Ore transportation (open pits-crusher)	4.22	8.45
Storage before crusher	0.79	1.57
Unloading of ore (crusher area)	0.89	1.77
Primary crusher	1.11	11.12
Secondary crusher	2.02	20.18
Storage after crusher	0.24	0.48
Loading at the crusher area	0.81	1.62
Ore transportation (crusher – heap leach)	0.10	0.19
Unloading of ore (heap leach area)	0.81	1.62
Storage (heap leach area)	5.13	10.26
Dismantling of waste rock	6.76	13.51
Loading of waste rock	2.54	5.08
Transportation of waste rock (open pits-storage area)	8.22	16.45

[12] USEPA AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors (2009)

Source	Controlled (kg/hour)	Uncontrolled (kg/hour)
Unloading of waste rock	2.54	5.08
Storage of waste rock	3.45	6.91

USEPA Guidelines were also used for the emissions factor for dust from blasting, which was calculated as PM_{10} (kg/blast) = 52.32[13].

Gaseous Emissions

Exhaust emission values for the various onsite construction and operational mine activities and the type and number of engineering vehicles, their horse power and the emission factors are taken from USEPA guidelines[14] and are presented in Table 7-19.

Table 7-19: Exhaust Emission Factors for Onsite Mine Construction and Operation Plant and Equipment

Machinery / Equipment	Number	Engine Power (HP)	Emission (g/day)	
			SO_2	NO_2
Truck	29	483	273,112	672,013
Excavator	4	524	40,923	11,114
Driller	4	225	10,990	2,985
Grader	3	178	4,350	1,181
Dozer	2	185	4,514	1,226
ANFO Truck	1	201	327	805
Crane	1	185	1,804	4,440
Loader (ore and waste rock)	1	261	5,101	12,552
Loader (others)	1	149	2,903	7,145
Light vehicles	10	202	6,583	16,200
TOTAL			350,608	729,660
TOTAL (kg/hr)			14.6	30.4
TOTAL (g/s)			**4.05**	**8.4**

[13] AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources
[14] Exhaust Emission Factors for Non-road Engine Modelling-Compression-Ignition Report No. NR-009A, February 13, 1998; revised June 15, 1998

7.5.6 Onsite Mine Construction and Operation Impacts and Mitigation Measures

Dust

The nearest villages to the EIA Permitted Area are Öksüt, Zile and Tombak (each 3 km from the Project Area) and these may potentially be affected by dust from onsite mine construction and operation.

Blasting activities will be conducted in compliance with Turkish Regulations (as set out in *Chapter 2: Legal Framework*). Dust generated by blasting activities will be sudden and intense and is expected to settle quickly and that there will not be a prolonged impact to air quality (it is a transient impact).

PM_{10}

Maximum modelled dust emissions are presented in Table 7-20 and include construction and operation activities in the EIA Permitted Area but does not include blasting.

All dust emission values are below the Project Standard limit values.

Table 7-20: Maximum PM_{10} Dust Emissions during Onsite Construction and Operation of the Mine

Parameter	Location	Controlled (µg/m³)	Uncontrolled (µg/m³)	Project Standard (µg/m³)
PM_{10} Maximum annual emission value	In the EIA Permitted Area, directly north of WRD 720581, 4241309	0.43	0.87	40
PM_{10} Maximum 24 hour average emission value	Öksüt 716081, 4236809	5.5	11.1	50

The maximum emission results estimated by the dust model over 365 days (assuming one blasting activity everyday) are presented in Table 7-21 and indicates exceedance of the 24 hour average PM_{10} Project Standard six times over the space of one year, during the winter. The highest concentration occurs at the same point in the EIA Permitted Area, directly northeast of Keltepe pit. The dust emission values for other days are below the Project Standard limit values for maximum 24 hour average emission value of PM_{10}.

Table 7-21: Maximum PM_{10} Dust Emissions during Blasting over 365 days

Parameter	Date	Location	Modelled Value (µg/m³)	Project Standard (µg/m³)
PM_{10} Maximum annual emission value	N/A	In the EIA Permitted Area, directly northeast of Keltepe Pit	9.54	**40**
PM_{10} Maximum 24 hour average emission value	17 February	In the EIA Permitted Area, directly northeast of Keltepe Pit	68.48	**50**
	1 March		60.53	
	16 April		59.50	
	29 January		52.27	
	16 February		52.15	
	24 April		51.13	
	6 April		51.09	
	22 November		48.65	

Settled Dust

Maximum settled dust concentration values and the Project Standard are presented in Table 7-22. The maximum settled dust values predicted by the model over one year are below the Project Standard.

Table 7-22: Settled Dust during Onsite Construction and Operation of the Mine

Parameter	Location	Modelled Value ((mg/m^2-day)	Project Standard (mg/m^2-day)
Settled Dust Maximum concentration – short term	In the EIA Permitted Area, directly northeast of Keltepe Pit 719581.00, 4240809.00	157.76	200
Settled Dust Maximum concentration – long term	In the EIA Permitted Area, directly northeast of Keltepe Pit 719581.00, 4240809.00	18.10	200

Cumulative Values of PM_{10} and Settled Dust

Modelled results at the background measurement locations (Öksüt, Zile, Gömedi and Epçe) and ambient air quality measurement results and emissions modelled to be released during operation and blasting were assessed cumulatively as presented in Table 7-23.

It must be noted that blasting activity is intermittent whilst operational activities at the mine have continual characteristics. However, to represent the worst case scenario, the dust emission levels when blasting and operational emissions occurring concurrently have been calculated. The results are all below the Project Standards. Model output graphs presenting the diffusion of dust emissions are shown in *Annex H*.

Table 7-23: Cumulative Values of PM_{10} and Settled Dust during Onsite Construction and Operation of the Mine

Location	Parameter	Modelled value, Operation	Modelled Value, blasting	Ambient value	Cumulative Value	Project Standard
Öksüt	Daily PM_{10} ($\mu g/m^3$)	3.9	1.24	27.5	32.64	50 ($\mu g/m^3$)
	Settled dust (mg/m^2-day)	15	1.42	127	143.42	200 (mg/m^2-day)
Zile	Daily PM_{10} ($\mu g/m^3$)	3.7	0.09	24.8	28.59	50 ($\mu g/m^3$)
	Settled dust (mg/m^2-day)	10	0.16	45	55.16	200 (mg/m^2-day)
Yazıbaşı	Daily PM_{10} ($\mu g/m^3$)	1	0	39.12	40.12	50 ($\mu g/m^3$)
	Settled dust (mg/m^2-day)	2	0	(no values recorded)	-	200 (mg/m^2-day)
Gömedi	Daily PM_{10} ($\mu g/m^3$)	5.5	0	19.94	25.44	50 ($\mu g/m^3$)
	Settled dust (mg/m^2-day)	4	0	117	121	200 (mg/m^2-day)
Epçe	Daily PM_{10}	4	0	9.89	13.89	50 ($\mu g/m^3$)

Location	Parameter	Modelled value, Operation	Modelled Value, blasting	Ambient value	Cumulative Value	Project Standard
	(µg/m^3)					
	Settled dust (mg/m^2-day)	2	0	122	124	200 (mg/m^2-day)

Impact Assessment

Impacts relating to onsite construction and operational dust emissions are assessed as follows.

Impact	Dust impacts in villages surrounding the EIA Permitted Area (Öksüt, Zile, Yazıbası, Gömedi and Epçe) from Project construction and operation activities within the EIA Permitted Area.
Receptor Sensitivity	These settlements are of medium sensitivity
Impact Magnitude	The impact is expected to be: ▪ Direct as it is a direct result of onsite construction and operation of the mine; ▪ Of long-term duration as it will last from construction and throughout operation; ▪ Localised as it is expected to only spread within the immediate vicinity of the mine; ▪ Certain to occur due to the nature of the Project. The impact magnitude is medium, based on the modelling results and parameters of the impact.
Significance	The effect will be of minor adverse significance. (medium receptor sensitivity and medium impact magnitude)

Impact Mitigation

The following mitigation measures are recommended:

- Wetting and covering powdery materials transported on trucks;
- Enforcing speed limit for all Project vehicles;
- Washing facilities, such as hose-pipes and ample water supply, will be provided at site exits, including mechanical wheel spinners where practicable;
- If necessary, all vehicles will be washed down before exiting the construction site;
- Periodic wetting of the stockpiled material to maintain the humidity percentage at approximately 5%;
- Periodic wetting of the construction areas;
- Wetting of blasting areas immediately after blasting event;
- Adequate maintenance of vehicles, machinery and equipment;
- Provision of compacted granular wearing course material on all onsite roads;
- Restriction on vehicular usage in off-road areas and on informal tracks by daily visual observation;
- Particulate Matter monitoring will be routinely carried out during construction and operation at the monitoring locations outlined in Figure 7-2.

- (Öksüt, Zile, Yazıbası, Gömedi and Epçe), and the Grievance Procedure has been developed and implemented to ensure that OMAS can react promptly if any complaints are received.

Residual Effects

The residual effect will be negligible after implementation of mitigation measures.

Gaseous Emissions

The nearest villages to the EIA Permitted Area are Öksüt, Zile and Tombak (each 3 km from the Project Area) and these may potentially be affected by onsite vehicle emissions (NO_2 & SO_2) during mine construction and operation.

Maximum modelled NO_2 and SO_2 emission values are presented in Table 7-24 with coordinates and a description of their location. All operational phase NO_2 and SO_2 emission values are below Project Standards. Model output figures are presented in *Annex H*.

Table 7-24 Maximum Operations Phase NO_2 and SO_2 Concentrations during Construction and Operation of the Mine

Parameter		Location	Modelled Result (µg/m³)	Project Standard (µg/m³)
NO_2	Hourly	Just outside the EIA Permitted Area, to the southeast. 722081, 4239309	88.1	200
	Annual		3.66	40
SO_2	Daily	Just outside the EIA Permitted Area, to the east. 720081, 4241309	12.24	125
	Hourly		42.48	350
	Annual		1.76	20

The contribution of background NO_2 and SO_2 measurements to the modelled project emission results was also calculated. SO_2 and NO_2 were simulated annually and daily separately. Ambient NO_2 and SO_2 air quality measurements were conducted for two periods. Modelled results at the baseline measurement locations and ambient air quality measurement results were assessed cumulatively using long term values (annual). The results are presented in Table 7-25 which shows that cumulative values for SO_2 and NO_2 are below Project Standards. Model output graphs presenting the diffusion of SO_2 and NO_2 are presented in *Annex H*.

Table 7-25: Annual Cumulative Values of SO_2 and NO_2 during Construction and Operation of the Mine

Measurement Location	Cumulative Value* (µg/m³)		Project Standard Limit Values (µg/m³)	
	SO_2	NO_2	SO_2	NO_2
Öksüt	2.9	1.4	20	40
Zile	2.4	1.7		
Project Area	3.84	5.21		

*(Long term values + Background measurement)

Impact Assessment

Operational phase impact associated with the release of NO_2 and SO_2 are assessed as follows:

Impact	SO_2 and NO_2 on Öksüt, Zile and Tombak which are close to operation area
Receptor Sensitivity	These settlements are of medium sensitivity
Impact Magnitude	The impact is expected to be: ▪ Direct as it is a direct result of onsite construction and operation of the mine; ▪ Of long-term duration as it will last from construction and throughout operation; ▪ Localised as it is expected to only spread within the immediate vicinity of the mine; ▪ Certain to occur due to the nature of the Project. The impact magnitude is medium, based on the modelling results and parameters of the impact.
Significance	The effect will be of **minor adverse significance**. (medium receptor sensitivity and medium impact magnitude).

Impact Mitigation

The following mitigation measures are considered relevant during construction phase to mitigate impacts arising from the release of NO_2 and SO_2 during the operations phase:

- Use of diesel with low sulphur content;
- Use and maintain vehicles and equipment in accordance with manufacturer guidelines;
- Replace vehicles / equipment when its condition is observed to be deteriorating excessively.

A monitoring programme (including the monthly measurements) of NO_2 and SO_2 at nearby residential areas during the operation phase will be implemented.

Exhaust emissions from construction and transportation vehicles will be periodically monitored along with the requirements in the *Regulation on Control of Exhaust Gas Emission*s both in construction and operation phases of the Project

Residual Effects

The residual effect will be negligible after implementation of mitigation measures

7.5.7 Closure Phase Impacts and Mitigation Measures

Impacts during decommissioning phase are likely to be similar to construction of the mine and the same considerations describe during construction are applicable here as well.

7.5.8 Summary of Impacts and Mitigation Measures

A summary of potential impacts and proposed mitigation measures as described above are summarised in the Tables below.

Table 7-26: Construction Phase Impacts and Mitigation Measures

Impact	Receptor	Receptor Sensitivity	Impact Categorisation	Magnitude of Impact	Potential Effect Significance	Design and Mitigation Measures	Management Plans, Policies and Procedures	Residual Effect Significance
Dust emissions to atmosphere during construction of access road and water supply pipeline	Yukarı Develi, Zile Yazıbaşı, Gömedi and Epçe Villages	Medium	**Type** *Direct* **Duration** *Medium term* **Extent** *Local* **Likelihood** *Certain*	Medium	Minor	▪ Wetting and covering powdery materials transported on trucks; ▪ Enforce speed limits; ▪ Washing facilities, such as hose-pipes and ample water supply, should be provided at site exits, including mechanical wheel spinners where practicable; ▪ If necessary, all vehicles should be washed down before existing the construction site; ▪ Periodic wetting of the stockpiled material to maintain the humidity percentage at about 5%; ▪ Periodic wetting of the construction areas; ▪ Use of working machinery with low emissions; and good levels of maintenance; ▪ Vehicles will be maintained in good condition to ensure they are no louder than other, similar vehicles on the roadways; ▪ Adequate maintenance of vehicle and equipment; ▪ Provision of compacted granular wearing course on all graded roads; ▪ Restriction on vehicular usage in off-road areas and informal tracks.	Air Emissions Management Plan	**Negligible**

Impact	Receptor	Receptor Sensitivity	Impact Categorisation	Magnitude of Impact	Potential Effect Significance	Design and Mitigation Measures	Management Plans, Policies and Procedures	Residual Effect Significance
Dust emissions to atmosphere during construction of powerline	Residents along the powerline route.	Medium	**Type** *Direct* **Duration** *Short term* **Extent** *Local* **Likelihood** *Likely*	Low	Minor	In addition to mitigation measures outlined for dust above: ▪ A net cut and fill balance will be aimed for where the soil and rock types allow and stockpiling of material will be avoided. ▪ Unused topsoil will be returned to disturbed areas wherever appropriate. ▪ Consultation to inform occupants of nearby residential buildings of impending works and duration of works is recommended.	Air Emissions Management Plan	**Negligible**
Gaseous emissions to atmosphere during construction of access road and water supply pipeline	Yazıbaşı, Gömedi and Epçe Villages	Medium	**Type** *Direct* **Duration** *Medium term* **Extent** *Local* **Likelihood** *Certain*	Medium	Minor	▪ Selection of machinery and equipment with low emissions where practicable; ▪ Machinery and vehicles to be maintained and operated in accordance with manufacturer's recommendations.	Air Emissions Management Plan	**Negligible**

Table 7-27: Operation Phase Impacts and Mitigation Measures

Impact	Receptor	Receptor Sensitivity	Impact Categorisation	Magnitude of Impact	Potential Effect Significance	Design and Mitigation Measures	Management Plans, Policies and Procedures	Residual Effect Significance
Dust emission to atmosphere	Öksüt, Zile, Yazıbası, Gömedi and Epçe	Medium	**Type** *Direct* **Duration** *Long term* **Extent** *Local* **Likelihood** *Certain*	Medium	Minor	▪ Wetting and covering powdery materials transported on trucks; ▪ Enforce speed limits; ▪ Washing facilities, such as hose-pipes and ample water supply, should be provided at site exits, including mechanical wheel spinners where practicable; ▪ If necessary, all vehicles should be washed down before existing the construction site; ▪ Periodic wetting of the stockpiled material to maintain the humidity percentage at about 5%; ▪ Periodic wetting of the construction areas; ▪ Wetting of blasting areas immediately after blasting event; ▪ Provision of compacted granular wearing course on all onsite roads; ▪ Restriction on vehicular usage in off-road areas and informal tracks.	Air Emissions Management Plan	**Negligible**
Gaseous emissions to atmosphere	Tombak, Öksüt and Zile Villages	Medium	**Type** *Direct* **Duration** *Long term* **Extent** *Local* **Likelihood** *Certain*	Medium	Minor	▪ Selection of machinery and equipment with low emissions where practicable; ▪ Machinery and vehicles to be maintained and operated in accordance with manufacturer's recommendations.		

Table 7-28: Closure Phase Impacts and Mitigation Measures

Impact	Receptor	Receptor Sensitivity	Impact Categorisation	Magnitude of Impact	Potential Effect Significance	Design and Mitigation Measures	Management Plans, Policies and Procedures	Residual Effect Significance
Dust emission to atmosphere	Öksüt, Zile, Yazıbası, Gömedi and Epçe	Medium	**Type** *Direct* **Duration** *Medium term* **Extent** *Local* **Likelihood** *Certain*	Medium	Minor	▪ Wetting and covering powdery materials transported on trucks; ▪ Enforce speed limits; ▪ Washing facilities, such as hose-pipes and ample water supply, should be provided at site exits, including mechanical wheel spinners where practicable; ▪ If necessary, all vehicles should be washed down before existing the construction site; ▪ Periodic wetting of the stockpiled material to maintain the humidity percentage at about 5%; ▪ Periodic wetting of the construction areas; ▪ Provision of compacted granular wearing course on all graded roads; ▪ Restriction on vehicular usage in off-road areas and informal tracks.	Air Emissions Management Plan	**Negligible**
Gaseous emissions to atmosphere	Tombak, Öksüt and Zile Villages	Medium	**Type** *Direct* **Duration** *Medium term* **Extent** *Local* **Likelihood** *Certain*	Medium	Minor	▪ Selection of machinery and equipment with low emissions where practicable; ▪ Machinery and vehicles to be maintained and operated in accordance with manufacturer's recommendations.	Air Emissions Management Plan	**Negligible**

7.6 Greenhouse Gas Emissions

7.6.1 GHG Emission Estimate Methodology

The emission of GHGs during construction and operations are released from a number of activities that are common to both phases (for example use of vehicles for mining and transportation). As emissions occur from a range of sources, key emission factors during both of these phases of the Project have been considered.

The key GHG emission generating activities considered include:

- Fuel use – mobile vehicles.
  - Onsite vehicles;
  - Supply vehicles;
  - Personnel transport.
- Fuel use – stationary combustion
  - Diesel generators;
  - Boilers.
- Electricity consumption;
- Explosives;

There are several types of greenhouse gases emitted from Project related activities. A very high proportion of the emissions of GHG emitted from the Project will be CO_2.

7.6.2 OMAS GHG Emissions

The assessment of direct and indirect GHG emissions has been undertaken based on the standard Centerra assessment and reporting format used for all Centerra operations worldwide. This is summarised below.

GHG Emissions Intensity

Based on annual average gold production of 133,333 oz/yr, this equates to 0.317 t CO_2-e per ounce of gold produced. GHG emissions are benchmarked across all Centerra operations and are reported in the annual CSR report prepared by Centerra.

Figure 7-5: OMAS GHG Emissions Assessment

Electricity Consumption				
	kW	**Load Factor**	**kWh per year**	**MWh per year**
ADR Plant	2,100	75%	13,797,000	13,797
Crushing Plant	1,500	75%	9,855,000	9,855
Site Infrastructure (Admin., Truck shop, etc.)	600	60%	3,153,600	3,154
Off-site Infrastructure (Fresh water, Operations camp)	350	90%	2,759,400	2,759
				29,565
Turkey Emission Factor	0.865	Kg CO2 per kWh		
CO2 Emissions		TCO2 per annum		**25,574**
http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf				
Diesel Consumption				
Average annual use (over 10 years)	6.15	ML		
Emission factor (diesel)	2.689	kg CO2 per litre		16,537,350.00
CO2 Emissions	16.5374	Mkg CO2 per year		
CO2 Emissions		TCO2 per annum		**16,537.35**
http://www.epa.gov/otaq/climate/documents/420f14040a.pdf				
ANFO Consumption				
Average annual mining rate (over 9 years)	8.86	Mt		
Powder factor	0.33	kg per tonne		
Average annual ANFO consumption	2,929.80	Tonnes per year		
Emissions factor (ANFO)	170.00	kg CO2 per tonne ANFO		
CO2 Emissions		TCO2 per annum		**498.07**
http://bocorockwindfarm.com.au/FCKfiles/File/AGO%20workbook-feb2008.pdf				
Average Annual CO2 Emissions		**TCO2 per annum**		**42,609**

7.7 Monitoring Requirements

All monitoring requirements are set out as part of the OMAS Air Emissions Management Plan (OMAS-ESMS-AE-PLN- 001) and are also reproduced in Table 7-29 below.

Table 7-29: Air Quality Monitoring Requirements

Topic/Aspects	Monitoring Location	Parameters	Frequency
Meteorology	OMAS Weather Station	Temperature, Pressure, Humidity, Rainfall, Wind speed and direction, Evaporation / Sublimation	Continuous
Dust	Öksüt, Zile, Yazıbası, Gömedi and Epçe	TSP	Routinely. Minimum of every month

Topic/Aspects	Monitoring Location	Parameters	Frequency
Dust during construction of access road.	Yukarı Develi, Zile, Yazıbaşı, Gömedi and Epçe.	PM_{10} $PM_{2.5}$ Settled dust	Routinely. Minimum of every six days
Emissions during construction of the access road.	Yukarı Develi, Zile, Yazıbaşı, Gömedi and Epçe.	NO_2, SO_2,	Routinely
Fine Particulate Matter	Öksüt, Zile, Yazıbası, Gömedi and Epçe	PM_{10} $PM_{2.5}$	Routinely. Minimum of every six days
Greenhouse Gases	Various	O_2, CO, CO_2, CH_4, NO_2, SO_2, NH_3,	Routinely
HCN Gas	Two points on fence line close to villages of Zile and Öksüt. Other monitoring points as identified	HCN	Continuous
Workplace Inspections	All main workplaces	Not applicable	Daily