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Almaty International Airport

Environmental and Social Impact Assessment Report - Chapter 5

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Almaty International Airport

Environmental and Social Impact Assessment Report - Chapter 5

September 2025

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Acronyms and abbreviations

Abbreviation / Acronym	Definition
ALA	Almaty International Airport
APUs	Auxiliary power units
ATMs	Air traffic movements
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CEMP	Construction Environmental Management Plan
COPERT	Computer Programme to calculate Emissions from Road Transport
Defra	Department for Environment Food and Rural Affair's
EBRD	European Bank for Reconstruction and Development
EHS	Environmental Health and Safety
ESAP	Environmental and Social Action Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESR	Environmental and Social Requirement
GIIP	Good International Industry Practice
GSE	Ground Support Equipment
HDV	Heavy Duty Vehicle
ICAO	International Civil Aviation Organisation
IFC	International Finance Corporation
Kazhydromet	Kazakhstan Hydromet department
LDAR	Leak detection and repair
LTO	Landing and take-off
MAC	Maximum Allowable Concentration
MACda	Maximum Allowable Concentration daily average
MACmso	Maximum Allowable Concentration, or maximum single occurrence
MACwz	Maximum Allowable Concentration for working zone
MPE	Maximum Permissible Emission
$\mu g/m^3$	Micrograms per cubic meter
NIOSH	National Institute for Occupational safety and Health
NO_2	Nitrogen dioxide
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limits
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 microns (PM_{10})
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 microns ($PM_{2.5}$))
REL	Recommended Exposure Limit
SPZ	Sanitary Protection Zone
TAV	TAV Airports Holding Co.
VOC	Volatile Organic Compound
WHO	World Health Organisation

5 Air quality

5.1 Introduction

5.1.1 This chapter of the Environmental and Social Impact Assessment (ESIA) reports the findings of the air quality assessment for the Project. It describes the existing baseline conditions within the study area and evaluates the potential for significant environmental effects on air quality resulting from Project activities.

5.1.2 The assessment considers the magnitude of predicted emissions and the sensitivity of identified receptors. Where relevant, mitigation measures have been proposed to manage and minimise potential impacts, in accordance with national air quality standards and international best practice.

5.1.3 This chapter includes reference to the ESIA for the Almaty Airport Expansion undertaken in 2022 and makes use of the baseline monitoring undertaken at that time. Further information on the 2022 ESIA can be found in **ESIA Chapter 1: Introduction**.

5.2 Methodology

Applicable guidelines and standards

5.2.1 The assessment has been undertaken considering relevant legislation, standards, and guidance as summarised in the sections below.

National requirements

5.2.2 Within the Republic of Kazakhstan there are regulations which establish standards for ambient and working zones[1], including the following main documents:

- Environmental Code of Kazakhstan (2021 Amendment)[2]. This is the primary legal document governing environmental protection, including air quality. It introduced updated methodologies for emissions inventories and pollutant thresholds.
- RD 52.04.667-2005 “Documents on the State of Atmospheric Pollution in Cities for Informing Government Agencies, the Public, and the Population. General Requirements for Development, Structure, Presentation, and Content”.
- ҚР ДСМ-70 on the Approval of Sanitary Rules 'Sanitary and Epidemiological Requirements for Sanitary Protection Zones of Facilities Affecting the Environment and Human Health’, dated 11 January 2022.

5.2.3 The key types of norms used for the regulation of impact on air quality are described below:

- Maximum Allowable Concentration (MAC) – a concentration below which does not have a long lasting direct or indirect adverse impact on the present or future generations and that

[1] Ambient zones refer to outdoor environments whilst working zones refer to occupational environments.

[2] European Union (2021) Code of the Republic of Kazakhstan. Available at: https://wecoop.eu/wp-content/uploads/2021/04/2021-KZ-ENV-Code_full-text_en.pdf. Last accessed on 28/07/2025

does not affect human performance or have a negative impact on human health and/or sanitary conditions.

- Maximum Permissible Emission (MPE) – emission limit set for each stationary source of air pollution to prevent harmful emissions from the source creating surface concentrations exceeding MACs when taking into account cumulative impacts from other pollution sources of a city or town and from the prospective sources coming from the development of industries.
- Maximum Allowable Concentration for working zone (MACwz) - the concentration of harmful substances in the air during working hours (except holidays) for not less than 8 hours a week or more than 40 hours a week.
- Maximum Allowable Concentration, or maximum single occurrence (MACmso) - the concentration of harmful substances in the air of populated areas, which after 20 minutes does not cause reflex (or sub sensorial) reactions in human health.
- Maximum Allowable Concentration daily average (MACda) - the concentration of harmful substances in populated areas. The levels of pollutants should not influence human health directly or indirectly after inhaling them for an unlimited period of time (years). Thus, MACda is calculated for all groups in a population, and for an indefinitely long averaging period. They apply to all populated areas and are consequently considered the strictest of the Republic of Kazakhstan standards for air quality.

5.2.4 A summary of relevant national ambient air quality standards is presented in Table 5.1.

International requirements

International Finance Corporation (IFC) Requirements

5.2.5 The IFC provide a portfolio of Standards and Guidelines that should be adhered to for any project seeking IFC finance. The IFC Performance Standard 3: Resource Efficiency and Pollution Prevention[3] aims:

"To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities"

5.2.6 To achieve this, the IFC provides both industry-specific and general guidance on Good International Industry Practice with respect to ambient air quality and emissions to air. The Project will need to comply with the IFC Performance Standards, and the standards set out in the IFC Environmental Health and Safety (EHS) General Guidelines Air Emissions and Ambient Air Quality[4] and the IFC EHS Guidelines for Airports 2007[5].

5.2.7 The IFC General EHS Guidelines advise that 'relevant standards' with respect to ambient air quality are national legislated standards or, in their absence, the current World Health Organisation (WHO) Air Quality Guidelines or other internationally recognised sources. As the Republic of Kazakhstan has its own nationally legislated standards, as described above, these legislated standards have been used to determine significance of potential ambient impacts.

5.2.8 Table 5.1 also presents the nationally legislated ambient air quality standards along with the European Union (EU) ambient air quality standards applicable from 1 January 2030[6].

[3] International Finance Corporation (2012). IFC Performance Standard 3: Resource Efficiency and Pollution Prevention

[4] International Finance Corporation, World Bank Group, General Environmental Health and Safety Guidelines Air Emissions and Ambient Air Quality (2007)

[5] International Finance Corporation, World Bank Group, Environmental Health and Safety Guidelines for Airports (2007)

[6] European Union, Directive 2024/2881 of the European Parliament and of the council of 23 October 2024

5.2.9 The General EHS Guidelines specifically refer to the EU Directives as being an 'internationally recognised source' of ambient air quality standards. The EU legislation introduces a threshold of tolerance to account for exceptional, worst-case episodes. This translates as a limit not to be exceeded more than a certain number of times and can be expressed as a 'percentile'.

5.2.10 The IFC General EHS Guidelines suggest that, as a general rule, emissions should not contribute more than 25 percent of the relevant air quality standards to allow additional, future sustainable development in the same airshed. Therefore, the significance of the impact of the Project has been discussed in the context of this approach.

5.2.11 The IFC also requires occupational health and safety to be assessed against appropriate standards. This assessment has used occupational health and safety standards prepared by the UK's Health and Safety Executive for a comparison against national standards.

European Bank for Reconstruction and Development (EBRD) Requirements

5.2.12 The Project has been assessed against the guidance provided by the EBRD Environmental and Social Policy (Environmental and Social Requirement) (ESR) ESR3: Resource Efficiency and Pollution Prevention and Control[7], the objectives of which are:

"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"

5.2.13 ESR3 refers to EU substantive environmental standards[8] and requires projects to be structured so that these can be applied at the project level.

"When host country regulations differ from the levels and measures presented in EU substantive environmental standards or other appropriate environmental standards identified, projects will be required to meet whichever is more stringent."

5.2.14 ESR3 also states "The client will structure the project to meet relevant EU substantive environmental standards, where these can be applied at the project level". It further clarifies how this should be implemented and confirms "For the purpose of this ESR, EU substantive environmental standards can be applied at the project level where the EU secondary legislative document itself contains clear quantitative or qualitative requirements that are applicable at the project level (as opposed to, for example, the ambient level)." Therefore, emissions that can be controlled at the project level must target the more stringent of the national or international standard, whereas relevant ambient air quality standards are those that are nationally legislated, with international air quality standards being applicable in the absence of national ambient air quality standards.

5.2.15 On this basis, the national ambient air quality standards are the primary standards applicable to the Project, with international air quality standards being applicable in the absence of national ambient air quality standards.

Summary

5.2.16 Table 5.1 presents the ambient air quality standards relevant to the emissions sources for the protection of human health for nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) which are relevant to the Project and are hereafter referred to as the 'standards', adopted for this assessment.

[7] European Bank for Reconstruction and Development (2024). Environmental and Social Policy

[8] Substantive environmental standards of the EU are comprised in EU secondary legislation, e.g., regulations, and directives. Procedural norms directed at Member States and EU institutions and the jurisprudence of the European Court of Justice and the Court of First Instance which applies to Member States, EU institutions and EU legal and natural persons, are excluded from this definition.

5.2.17 Table 5.2 presents relevant Volatile Organic Compound (VOC) limits recommended by the IFC, based on internationally recognised sources, and the Republic of Kazakhstan. Monitored VOC concentrations from the baseline surveys undertaken for the Project will be compared against these standards for the protection of human health.

Table 5.1: Relevant ambient air quality standards for the protection (µg/m^3)

Pollutant	Averaging period	European Union standards[(a)]	Republic of Kazakhstan standards
Nitrogen dioxide (NO_2)	20 minutes	-	200
	1 hour	200[(b)]	-
	24 hour	50[(c)]	40
	Annual	20	-
Particulate matter (PM_{10})	20 minutes	-	300
	24 hour	45[(c)]	60
	Annual	20	-
Particulate matter ($PM_{2.5}$)	20 minutes	-	160
	24 hour	25[(c)]	35
	Annual	10	-

Notes: (a) to be attained by 1 January 2030; (b) 99.97th percentile (c) 95.07th percentile

Table 5.2: Summary of relevant VOC ambient air quality standards for protection of human health (µg/m^3)

Pollutant	Applicable international standards	Kazakhstan Maximum Allowable Concentrations (MAC)	
	Annual	20 minute	24 hour
Benzene (a)	3.4	300	100
Toluene (b)	1,910	600	-
Ethylbenzene (b)	4,410	20	-
Xylene (b)	4,410	200	-

Source: (a) EU Limit values (b) Derived from Health and Safety Executive EH40/2001 occupational limits for 2001

5.2.18 Occupational standards are available from the Republic of Kazakhstan and from a variety of international sources including The National Institute for Occupational Safety and Health (NIOSH) and the UK Health and Safety Executive. The NIOSH provides occupational exposure limits for NO_2. Occupational exposure to NO_2 is compared against two averaging periods which include Recommended Exposure Limit (REL) for a 15-minute time weighted average and an 8-hour time weighted Permissible Exposure Limits (PEL) as suggested by the Occupational Safety and Health Administration (OSHA).

5.2.19 Table 5.3 presents the appropriate NO_2 occupational standards used as the basis for this assessment.

Table 5.3: Relevant NO_2 occupational exposure standards

Occupational standards	Concentrations (µg/m^3)
15-minute NIOSH REL	1,800
8-hour OSHA PEL	9,000
20-minute Kazakhstan MAC	2,000

Source: https://www.cdc.gov/niosh/

REL - Recommended Exposure Limit; PEL - Permissible Exposure Limits

5.2.20 Relevant occupational exposure standards for VOCs applicable within the airport boundary are presented in Table 5.4. These are based on 8-hour averaging periods and have been used as an indication of potential risk to onsite workers.

Table 5.4: Relevant VOC occupational exposure standards

Pollutant	International standards		Kazakhstan Maximum Allowable Concentrations
	ppm	mg/m^3	mg/m^3
Benzene	1	3.25	5
Toluene	50	191	50
Ethylbenzene	100	441	50
Xylene	50	220	50

Source: UK Health and Safety Executive EH40/2005,

Notes: ppm – parts per million, based on 8-hour averaging period

Area of Influence for air quality

5.2.21 The area of influence with regards to air quality is the area that could potentially be affected by emissions to air during the construction and operational phases.

5.2.22 During construction this is confined to a small area located around the construction site and the main transport routes. Construction effects are temporary and are located within 500m of the construction activity.

5.2.23 The operational phase effects would be experienced throughout the life of the Project and will be located within 200m of the access roads and approximately 1km from the airfield for airside activities.

Sensitive receptors

5.2.24 Sensitive receptors with regards to air quality are members of the public, people at work or sensitive business or activities that could be affected by dust or changes in pollutant concentrations.

5.2.25 The sensitivity of receptors depends on the type and location in relation to the specific phase, i.e. construction or operation.

5.2.26 Key receptors related to the construction and operation phases are described below under the methodology for the air quality impact assessment.

Methodological approach

5.2.27 This section of the chapter presents the methodology applied to the assessment of impacts.

Construction phase methodology

Public Health

5.2.28 Construction activities can result in temporary effects from dust. ‘Dust’ is a generic term which usually refers to particulate matter in the size range 1-75 microns. The nature of the area and activities to be carried out means that emissions of construction dust are predominantly associated with the movement and handling of subsoil minerals and composed of the larger fractions of this range which do not penetrate far into the respiratory system. Therefore, the primary air quality issue associated with the construction phase is typically the loss of amenity and/or nuisance caused by dust emissions, such as the soiling of buildings and vegetation, or reduced visibility.

5.2.29 Dust deposition can be expressed in terms of mass per unit area per unit time, e.g. mg/m^2/month. No relevant Kazakhstan, IFC or EBRD standards exist for dust deposition; however, a range of criteria from 133 to 350 mg/m^2/month is found around the world as representative of thresholds for significant nuisance.

5.2.30 It is considered that a quantitative approach is inappropriate and unnecessary for assessing particulate emissions associated with the construction phase of the Project. The activities undertaken during the construction phase are likely to increase dust emissions in the area. However, on the basis that construction activities can be easily mitigated, a qualitative assessment of dust effects to inform the level of mitigation and subsequent likely impact is appropriate.

5.2.31 The first stage of the assessment has involved the identification of construction activities which have the potential to cause dust emissions, and the degree of that potential. Table 5.5 provides a list of potential construction activities. Selected information from this table has been used within this assessment to determine the impact of the Project with respect to construction dust.

Table 5.5: Relevant dust generating activities

Potential dust emitting activities	Description	Dust emission potential
Demolition	Potential to be high given that the main runway and existing in-flight catering facility are made of concrete which is a potentially dusty construction material.	High
Groundworks and foundations	Potential to be high, depends on time of year and soil dryness	High
Storage of materials onsite	Potential to be high, depends on time of year and material (e.g. soils and aggregate) dryness	High
Transport of materials within site	Can be high depends on type of transport and nature of road surface	Medium
Transport of material offsite	Generally low as transport occurs by surfaced roads	Low
Construction of new buildings and airport infrastructure	Generally low although some activities with high dust raising such as material cuttings and concrete batching can occur	High

5.2.32 In the second stage of the assessment, all sensitive receptors with the potential to be significantly affected by construction dust emissions have been identified. The distances from source at which construction dust effects are felt are dependent on the extent and nature of mitigation measures, prevailing wind conditions, rainfall and the presence of natural screening by, for example, vegetation or existing physical screening such as boundary walls on a site. Effects from construction activities that generate dust are generally limited to within 150-200m of the activity, however, to undertake a conservative assessment, receptors within 500m have been considered.

5.2.33 Table 5.6 presents key examples of sensitive receptors located within 50m of the construction boundary. While some receptors, such as the airside apron and taxiways, extend beyond this distance, they are only listed in the closest relevant band to avoid duplication. The table is not intended to be exhaustive but highlights representative receptor types and their sensitivity classifications for the purposes of the dust impact assessment.

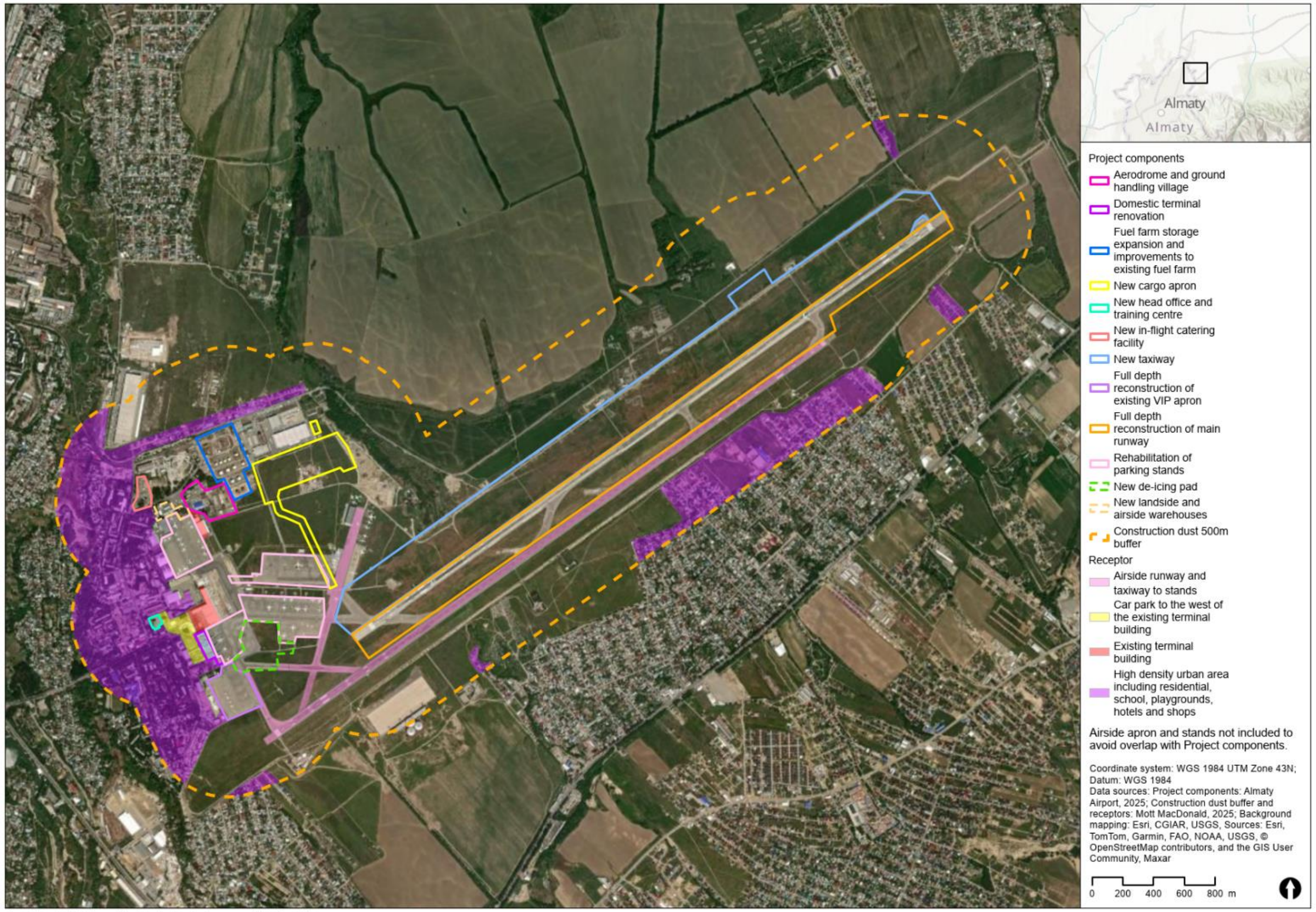
5.2.34 See Figure 5.1 below for construction dust receptors within 500m of construction activities.

Table 5.6: Receptor sensitivity classification

Distance from source	Receptor type and sensitivity		
	High	Medium	Low
Within 50m	Existing airside apron, aircraft stands, taxiway and runway 05R-23L. High density urban area including residential, school, playgrounds, hotels and shops	Car park to the west of the VIP apron. Existing terminal building	Vegetation on the airfield and in urban areas

Note: As detailed in paragraph 5.2.33, while some receptors listed in the table above extend up to 500m, which is the study area distance, they are only listed in the closest relevant band (i.e. within 50m) to avoid duplication.

Figure 5.1: Construction dust receptors within 500m of construction activities



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5.2.35 At this stage, the exact number of vehicle movements required during the construction phase is not known. Guidance from the UK advises that significant effects are unlikely to occur where there are less than 200 Heavy Duty Vehicle (HDV)[9] movements per day as an annual average for a period. Where construction activities are less than two years it is unlikely that the construction activities would constitute a significant air quality effect given the short-term duration of the construction activities as opposed to the long-term operation of the Project[10]. It has been assumed that construction HDV movements will be lower than this and are anticipated to utilise Mailin Street as the primary access to the airport, avoiding residential streets where possible.

5.2.36 Therefore, it is considered highly unlikely that significant effects would arise from construction phase vehicle movements and they have not been considered further. However, general mitigation measures to help reduce emissions have been provided in Table 5.23.

5.2.37 In addition, emissions from on-site construction plant are not expected to be significant and have not been assessed further due to the distance from sensitive receptors and the limited construction period; nevertheless, best practice mitigation measures have been included in Table 5.23 to minimise these impacts.

Occupational Health

5.2.38 Dust generated during the construction phase is not expected to cause an occupational exposure risk following standard dust suppression mitigation and has not been considered further. Mitigation measures to minimise emissions from onsite combustion plant have been presented in Table 5.23.

Operational phase methodology – public health

Operational phase traffic

5.2.39 The completion of the Project will improve the airport's capacity in line with projected passenger and cargo traffic growth and will contribute to the airport being able to handle additional passenger numbers. Whilst it is expected that a proportion of these will be 'in-transit' passengers as the airport aims to increase its 'hub' activities, there will be increased journeys to and from the airport from other passengers. Currently there is no onsite rail link to the airport and therefore these additional journeys will likely be made by car or bus.

5.2.40 Mailin Street has been considered within the assessment of operational traffic as this is likely to represent the road with the largest impacts from additional traffic from the Project. Increases in operational traffic on other roads, such as Zakarpatskaya Street, will be lower than those on Mailin Street and therefore air quality impacts will also be lower.

5.2.41 Considering the limited information on detailed traffic information for existing and future traffic flows, existing traffic flows along Mailin Steet were estimated from a three-day traffic survey undertaken in 2021 at locations in close proximity to where ambient air quality monitoring has been undertaken. This has been used to estimate the proportion of traffic on Mailin Street that is associated with the airport and the proportion which is local road traffic by using data from the airport vehicle entrance and exit barriers. This survey indicated that approximately 60 percent of traffic on Mailin Street was local traffic and the remaining 40 percent was associated with the airport.

[9] An HDV is any vehicle with a gross weight greater than 3.5 tonnes. This includes heavy goods vehicles (i.e. those used to transport goods) but can also include other large vehicles that may be used during construction such as waste collection, mobile road-going cranes and other specialist equipment.

[10] National Highways (2024). Design Manual for Roads and Bridges Sustainability & Environment Appraisal LA 105 Air Quality

5.2.42 Many of the assumptions used to inform the assessment of road traffic impacts are based on predicted future usage of the airport. These predictions are based on best estimates at present and could change in future years. Nevertheless, to address this uncertainly and to undertake a conservative assessment, future road traffic at the airport has been estimated based on anticipated demand and growth at the airport. These estimates do not account for whether the infrastructure can accommodate such increases. In addition, traffic flows for the future year of 2030 without the Project in place are not available. As such, future baseline traffic flows have been assumed to be equal to base year traffic flows for 2021. As this does not account for non-Project related growth in traffic numbers between these years, the difference between the future year traffic flows without and with the Project is likely to be overestimated, therefore increasing the predicted change in pollutant concentrations which represents a conservative assessment.

5.2.43 Table 5.7 presents the traffic data used in the assessment.

Table 5.7: Assumed traffic data

Road	2021 flows (total)	% HDV	2030 without Project	%HDV	2030 with Project	%HDV
Mailin Street	44,500	3.3	44,500	3.3	52,000	3.3

Note: % HDV means percentage of total traffic flows that are heavy duty vehicles

5.2.44 To predict the increase in pollutant concentrations as a result of increased traffic, an assessment has been undertaken using the dispersion co-efficient equations presented within the National Highway's Design Manual for Roads and Bridges screening model. The screening model is designed to be conservative, meaning it is more likely to overestimate rather than underestimate pollutant concentrations. Emission factors are based on the European Environment Agency's Computer Programme to calculate Emissions from Road Transport (COPERT) emission calculation tool and are considered suitable for use in Kazakhstan. The COPERT emissions have been processed using the UK's Department for Environment Food and Rural Affair's (Defra) Emission Factor Toolkit.

5.2.45 It is acknowledged that the existing vehicle fleet in Kazakhstan does not meet the most recent EURO emission standards. Therefore, emissions produced for the existing fleet composition takes account of the older fleet and more polluting vehicles which are currently present. Future year projections have also been manually adjusted to include a greater proportion of older more polluting vehicles and to undertake a conservative assessment.

5.2.46 Table 5.8 presents the approach and assumptions used in the assessment.

Table 5.8: Summary of assumptions used in assessment

Parameter	Assumption
Conversion of NOx to NO_2	The assessment has assumed a 50% conversion rate of NOx to NO_2
Background NO_2 concentrations	The assessment has assumed a background concentration of NO_2 of 45µg/m^3, measured at Almerek Village, for the base year of 2021 and is based on the monitoring data collected as part of the ESIA produced for the Almaty Airport Expansion in 2022 at locations away from emission sources. To determine future concentrations, no change in baseline concentrations has been assumed which is a conservative assumption as it would be expected to decline in future years as newer less polluting cars enter the fleet.
Speed	The assessment has assumed the traffic is travelling at 40kph which is the speed limit of Mailin Street.
Pollutants considered	The assessment of impacts has considered NOx, NO_2, PM_{10} and $PM_{2.5}$. Emissions of other pollutants, such as sulphur dioxide and

Parameter	Assumption
	VOCs, from road transport are de minimis relative to those listed here and have not been considered further.
Euro class assumptions	In 2021 it has been assumed that cars, light goods vehicles and heavy good vehicles will have a 50/50 split between Euro 2/II and Euro 3/III emissions. In 2030, it has been assumed 25% of cars and light good vehicles will meet Euro 4 standards, 50% Euro 5 standards and 25% Euro 6 standards. 25% of HDVs have been assumed to meet Euro III standards and 75% Euro IV standards.

Onsite energy plant

5.2.47 There is no new onsite energy plant associated with the Project; electricity will be supplied from the Kazakhstan electricity grid and heating will be supplied by existing district heating supplies. On this basis, no further assessment of onsite energy plant has been undertaken.

Fuel storage

5.2.48 As detailed in Section 2.5 of **ESIA Chapter 2: Project description**, fuel operations currently encompass reception, storage, accounting, quality control, fuel dispensing, and aircraft refuelling. In response to growing traffic and the recent construction of the new international terminal, which was part of the Almaty Airport Expansion assessed in the 2022 ESIA, it is proposed that additional fuel storage infrastructure is constructed, and the existing fuel farm is improved, which is located within the northern part of the airport boundary.

5.2.49 Airport fuel operations during the operational phase have the potential to impact air quality as a result of fugitive emissions associated with equipment such as leaking pipes, valves, connections, flanges and seals as well as general loading, unloading and storage operations. However, the upgrade of the existing fuel farm will modernise the equipment, incorporating the latest techniques and industry best practice. It is considered that Good International Industry Practice (GIIP) will be followed in the design stage and during maintenance of the Project to control and reduce fugitive emissions, and to select equipment that meets both safety, suitability and fugitive emission control requirements.

5.2.50 As fugitive emissions are controlled through design and maintenance, there is no potential for significant adverse effects from fugitive emissions during the operational phase and fugitive emissions have not been considered further. However, measures to monitor fugitive emissions of VOCs in accordance with GIIP are recommended in Table 5.23.

Airside emissions

5.2.51 Impacts on air quality from airside emissions have considered:

- The projected increase in air traffic movements (ATMs) quantitatively
- An increase in Ground Support Equipment (GSE) quantitatively
- Increases in emissions from auxiliary power units (APUs) whilst aircraft are on a stand due to increased ATMs qualitatively

5.2.52 Emissions from the ATMs, specifically the landing and take-off (LTO) cycle, and GSEs have been considered quantitatively following the ‘simple’ approach set out in the International Civil Aviation Organisation (ICAO) Air Quality Manual[11]. The additional emissions from the ATMs and GSEs have been considered in the context of existing air quality. As with future road traffic data,

[11] ICAO (2015). Airport Air Quality Manual. CAEP10 Steering Group 2015 Approved Revision (Based on the First Edition – 2011).

future air traffic data has been based on projected demand and growth at the airport and does not account for whether the existing infrastructure can accommodate such increases.

5.2.53 NOx, particulate matter and VOCs are considered to be the primary pollutants associated with airside emissions and GSEs. However, impacts from airside operations have been considered using concentrations of NOx only. This is because emissions from other pollutants, such as particulates and sulphur dioxide, from the primary airfield sources, such as aircraft engines, are negligible relative to NO_x. On the basis that fuel and other sources of VOCs are managed in accordance with GIIP, emissions of VOCs are also considered to be negligible.

5.2.54 NO_x emissions from the likely increase in LTOs have been estimated by multiplying the number of LTO cycles for each aircraft class for 2025 (base year) and 2030 (future year)[12] respectively, with the corresponding NOx emission factor for the aircraft as specified in Table B-1 of the ICAO Air Quality Manual. Aircraft have been categorised into six groups (A-F), and within each group, the highest emission factor across the corresponding aircraft models (e.g. Airbus A300) within that group has been used for the calculations[13]. The values across all aircraft groups were then aggregated to calculate the total NO_X emissions from LTOs. The approach assumes that the operational conditions are consistent with the ICAO data used, and does not consider variations in engine models, operational settings, or Time in Mode. Nevertheless, given the absence of detailed data on aircraft operational parameters, the ICAO simple methodology is considered suitable for the prediction of annual mass emissions from the LTO cycle.

5.2.55 GSE emissions have been calculated by multiplying the number of aircraft movements and ICAO NO_X emission factors for GSE technology, which are presented in Table 3-A2-4 of the ICAO Air Quality Manual, together. The ICAO GSE emission factors are categorised by age and size of aircraft (narrow-body or wide-body) being supported and have been used in the absence of Project-specific emission factors for the GSE fleet. The average age of the GSE fleet at the airport is 10.7 years. However for the assessment, ICAO GSE emission factors for 1990-2005 have been used as a worst-case approach, given that older technology has higher emissions and the GSE contributions to the total airside emissions are relatively low compared to the ATMs. The GSE emissions associated with the different size of aircrafts (i.e. narrow-body or wide-body) were then aggregated to calculate the total NO_X emissions from GSE.

5.2.56 The emissions from the LTOs and GSEs were combined to calculate the total emissions and the change in total emissions between the current and future was then calculated. The potential impact of the change in total emissions on nearby sensitive receptors was then assessed qualitatively.

5.2.57 In addition, as part of the Environmental and Social Action Plan (ESAP) produced for the Almaty Airport Expansion in 2022, the airport committed to reducing APU operation times by 50% to help reduce emissions, decreasing usage from 40 minutes to 20 minutes before take-off, and from 20 minutes to 10 minutes after landing. The '8th Site Visit Report"[14] prepared by SE Solutions (Pty) Ltd confirms that this target was successfully achieved during the eighth site visit that took place in Q1 2025. It is considered that these measures will control any additional emissions associated with the increased number of APUs. As such, significant adverse effects from APU emissions during the operational phase are unlikely and have not been considered further.

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[12] Given the assumptions relating to aircraft emissions and uncertainty relating to future technologies bringing reductions in emissions from aviation, it is not considered suitable to project mass emissions from individual projects in the aviation sector beyond the first future year as the likelihood of uncertainty and error increases.

[13] The aircraft models within each group are based on monitored 2024 flight data and has been assumed to be the same for 2025 and 2030.

[14] This is the eighth report in a series of reports that detail project compliance with the ESAP for the Almaty Airport Expansion in 2022

Operational phase methodology – occupational health

5.2.58 Operational phase occupational risks have been assessed qualitatively considering existing pollutant concentrations and relevant occupational air quality standards.

Determination of Significance

5.2.59 Determining the significance of effects identified is one of the main purposes of an environmental assessment and enables the identification of necessary mitigation measures. An environmental impact can be either beneficial or adverse and is assessed by comparing the quality of the existing environment with the predicted quality of the environment once a project is in place.

5.2.60 In order to describe the significance of an effect it is important to distinguish between two concepts: ‘magnitude’ and ‘sensitivity’. The application of these concepts for this assessment is outlined in **ESIA Chapter 4: ESIA scope and methodology** and should be read in conjunction with this chapter. This section describes how the significance criteria for the operational phase has been derived based on an assessment of magnitude of the impact and receptor sensitivity.

Construction Phase

5.2.61 A combination of dust emission potential from on-site activities and expected durations presented in Table 5.5 has been used to determine the impact magnitude of the construction phase. Table 5.9 sets out how the dust raising magnitude is determined using dust raising potential and duration.

Table 5.9: Determination of impact magnitude – construction phase

Dust raising potential[(a)]	Duration	Magnitude
High	Any	Major
Medium	>3 months	Moderate
Medium	<3 months	Minor
Low	Any	Negligible

Notes: [(a)] Dust raising potential defined in accordance with the approach described in Section ‘Construction phase methodology’.

5.2.62 Receptor sensitivity has been determined based on the type of receptor and the distance from the construction boundary or activity that the receptor is located. Table 5.10 presents how the receptors classification and the distance the receptor is from construction activities has been used to determine sensitivity.

Table 5.10: Determination of receptor sensitivity – construction phase

Receptor classification	Distance to activities			
	0-50m	50-100m	100-200m	200-500m
High	High	High	Medium	Low
Medium	Medium	Medium	Low	Low
Low	Medium	Low	Low	Negligible

Notes: Receptors classified based on method described in Section ‘Construction phase methodology’.

5.2.63 In summary, the magnitude of impacts is a product of the types of activities carried out and their durations. The receptor sensitivities are a product of the receptor type and their distance to the construction activities.

5.2.64 Following the determination of magnitude and sensitivity, the significance of impacts and therefore overall risk of dust effects from the construction phase has been evaluated based on the significance matrix presented in **ESIA Chapter 4: ESIA scope and methodology**.

Operational Phase

5.2.65 The General EHS Guidelines classify 'poor quality airsheds' as those where relevant standards are exceeded significantly. Therefore, receptors experiencing baseline ambient pollutant concentrations above the relevant standards are concluded to be of 'high' sensitivity.

5.2.66 For each of the pollutants considered, different air quality standards are applicable. Table 5.11 presents the determination of impact magnitude and this is determined based on the change in pollutant concentrations compared to the relevant air quality standard that a project results in. Table 5.12 presents the determination of receptor sensitivity for the operational phase which is determined based on the existing baseline compared to the relevant ambient air quality standards.

5.2.67 Following the determination of magnitude and sensitivity, the significance of effects from the operational phase has been evaluated based on the significance matrix presented in **ESIA Chapter 4: ESIA scope and methodology.**

Table 5.11: Determination of impact magnitude – operational phase

Change in concentrations as % of standards	Magnitude
Increase >25%	Major
Increase 15-25%	Moderate
Increase 5-15%	Minor
Increase <5%	Negligible

Table 5.12: Determination of receptor sensitivity – operational phase

Baseline concentration as a percentage of relevant air quality standard	Magnitude
Increase >25%	High
Increase 15-25%	Medium
Increase 5-15%	Low
Increase <5%	Negligible

Limitations and assumptions

5.2.68 The assessment of air quality impacts has been based on the most up to date and best information available at the time of assessment.

5.2.69 The assessment of operational road traffic has been based on assumptions as set out within the methodology in paragraphs 5.2.39 to 5.2.46. There is an inherent amount of uncertainty with the approach used, namely:

- Assumptions about baseline pollutant concentrations
- Base traffic flows and projections used in the assessment
- Assumptions associated with NOx to NO_2 conversions
- Average speed of traffic flow

5.2.70 In order to reduce this uncertainly and provide an indication of the robustness of the assessment, base traffic data derived for 2021 for the assessment and the assumptions above have been used to predict concentrations for the location where NO_2 monitoring data has been collected on Mailin Street. The predicted results and the monitored data have been compared to determine if the various assumptions and approach is suitable.

5.2.71 The predicted roadside pollutant concentrations for 2021 were broadly in line with monitored concentrations (as shown in Table 5.19 and Table 5.14 where the predicted and monitored pollutant concentration is 78.4μg/m³ and 80μg/m³ respectively on Mailin Street) and indicated that the assumptions used within the assessment are appropriate. Therefore the approach is appropriate to provide an indication of the level of impact the Project would contribute to in future years.

5.2.72 Furthermore, the assessment of operational air traffic has been based on the following assumptions, in addition to those detailed in paragraphs 5.2.52 and 5.2.55:

- Aircraft emission factors are only publicly available for a limited number of aircraft type, therefore assumptions regarding aircraft type have been made to fill data gaps.
- It is assumed that there is no reduction in aircraft and GSE emission factors associated with replacement of fleet and improvements in technology in the future. This conservative assumption leads to a cautious and likely overestimate of airside emissions.

5.2.73 Airside mass emission calculations cannot be used to determine changes in pollutant concentrations in the surrounding area; however, they can be used to give an indication of change and, in conjunction with existing available ambient air quality monitoring in and around the airport, a qualitative analysis of impact and likely significant effects has been undertaken.

5.3 Baseline

Current baseline

Kazhydromet monitoring data

5.3.1 Ambient air quality monitoring is undertaken by the Kazakhstan Hydromet department (Kazhydromet) at multiple locations across Almaty. Data is publicly available for the preceding 24 hours and is forecast for the next 48 hours while historical data can be requested directly from the Hydromet department.

5.3.2 The closest station, No 28: Almaty, Aerological Station, Akhmetova Street, 50, is located approximately 800m to the north-west of the airport boundary and set back approximately 50m from the nearest main road. In addition, Station No 4: Almaty, Turksib district, comprehensive school No 32 is also located approximately 2.2km north-west of the airport. These monitors provide a good indication of air pollutant concentrations in the area surrounding the airport.

5.3.3 Figure 5.2 presents the locations of the monitoring stations. Historical data from these stations from the Kazhydromet between January 2022 and December 2024 have been provided and are presented in Table 5.13.

5.3.4 Monitored data indicates that NO_2 concentrations are generally high at both stations and likely to exceed or be close to exceeding air quality standards for the national 20 minutes (200 μg/m³) and 24-hour mean (40 μg/m³), international 1-hour mean (200 μg/m³) and annual mean (40 μg/m³). However, the monitoring data indicates that PM_{10} and $PM_{2.5}$ concentrations generally meet the national 20-minute 24-hour annual mean and international annual mean standards at both stations.

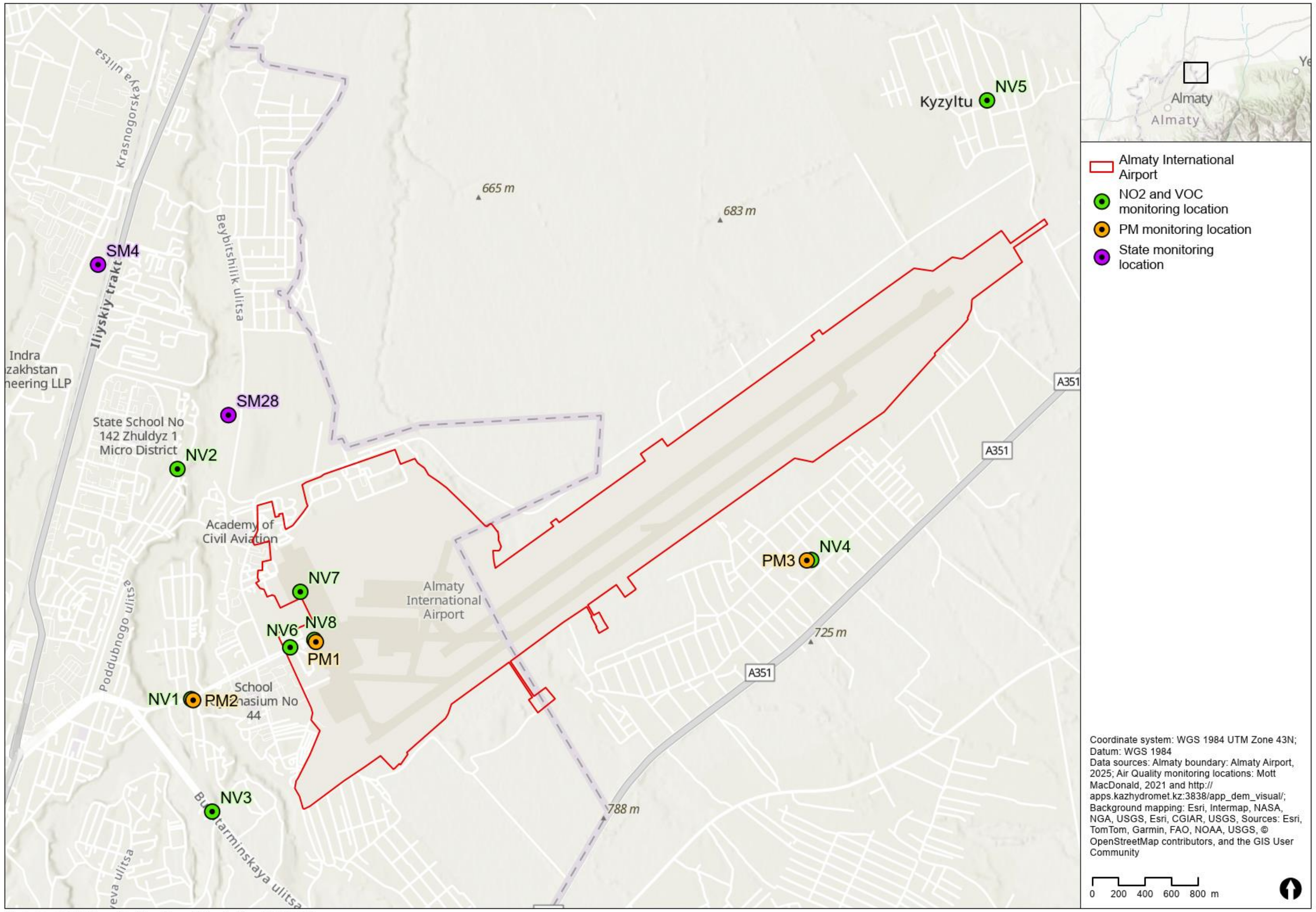
Table 5.13: Monitored NO_2, PM_{10} and $PM_{2.5}$ at Stations No.4 and No.28

Site ID	Year			
	2022	**2023**	**2024**	**Average**
Maximum 20 minute NO_2 concentration (μg/m³) – National standard 200μg/m³				
SM4	125	196	588	303
SM28	192	211	317	240
Maximum 1 hour mean NO_2 concentration (μg/m³) – International standard only 200μg/m³ at 99.97th percentile				

Site ID	Year			
	2022	2023	2024	Average
SM4	114	173	532	273
SM28	173	200	209	194
Maximum 24 hour mean NO_2 concentration (µg/m^3) – National standard 40µg/m^3				
SM4	55	78	294	143
SM28	89	104	86	93
Annual mean NO_2 concentrations (µg/m^3) – International standard only 20µg/m^3				
SM4	30	21	35	29
SM28	37	47	36	40
Maximum 20 minute PM_{10} concentration - National standard 300µg/m^3				
SM4	3	36	2	14
SM28	231	54	235	174
Maximum 24 hour mean PM_{10} concentration – National standard 60µg/m^3				
SM4	2	13	1	5
SM28	78	4	69	50
Annual mean PM_{10} concentrations (µg/m^3) – International standard only 20µg/m^3				
SM4	1	5	1	2
SM28	31	1	34	22
Maximum 20 minute $PM_{2.5}$ concentrations (µg/m^3) – National standard 160µg/m^3				
SM4	3	3	7	4
SM28	70	53	220	114
Maximum 24 hour mean $PM_{2.5}$ concentrations (µg/m^3) – National standard 35µg/m^3				
SM4	2	1	1	2
SM28	25	4	49	26
Annual mean $PM_{2.5}$ concentrations (µg/m^3) – International standard only 10µg/m^3				
SM4	1	1	1	1
SM28	9	2	23	11

Note: 2022 data capture: 95.3% for NO_2 and 97% for PM_{10} and $PM_{2.5}$. 2023 data capture: 95% for NO_2 and 83.5% for PM_{10} and $PM_{2.5}$. 2024 data capture: 97.1% for NO_2, 97.5% for PM_{10}, 97.2% for $PM_{2.5}$.

Figure 5.2: Air quality monitoring locations



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Airport Operation monitoring – 2020 to 2022

Gaseous monitoring

5.3.5 Monitoring was undertaken between 2020 and 2022 for the 2022 ESIA and utilised passive monitoring equipment commonly referred to as diffusion tubes for NO_2, Benzene, Toluene, Ethylbenzene and Xylene (BTEX). Diffusion tubes are passive samplers and rely on the physical movement of air through the tube (rather than air being drawn into the apparatus). The tubes contain a chemically active surface at one end coated on a small non-reactive metal grid. Once the active surface is exposed, a concentration gradient forms within the tube. The total concentration can be calculated based on this and the period that the tube has been exposed.

5.3.6 Diffusion tubes were located at eight sites, with BTEX and NO_2 monitoring being undertaken for three periods over a duration of six weeks[15] and nine weeks[16] respectively, both between January and March 2021. Locations of the monitoring sites used are presented in Figure 5.2. At each location, two tubes were deployed for NO_2 and the average concentrations of these two sites determined for each period of monitoring.

5.3.7 This monitoring was undertaken within the airport boundary, with three monitoring sites located within/adjacent to the Sanitary Protection Zone (SPZ), along the key access road and nearby villages, by specialists from EcoSocio Analysts LLC.

5.3.8 Table 5.14 presents the period mean of monitored pollutant concentrations for all of the monitoring locations for NO_2. The monitored data indicates that the period mean was high and although diffusion tube monitoring provides a long-term average across the monitoring period, it can be assumed that the national 24-hour standard for NO_2 was being exceeded at all monitoring locations as the period mean was above 40µg/m^3. The highest concentration was monitored along Mailin Street which is the main access route to and from the airport and is heavily influenced by road traffic. Concentrations in surrounding villages were lower than this, and lower than the concentrations monitored within the airport perimeter. However, concentrations in surrounding villages were still very high away from the main road and airport sources indicated that the high existing concentrations were driven by local sources such as heating for residential properties and meteorological conditions in winter months.

Table 5.14: Monitored NO_2 concentrations (µg/m^3) (dates are all in 2021)

Site ID	Location	Period 1 27th January – 17th February	Period 2 17th February – 11th March	Period 3 11th March – 31st March	Average
NV1*	Mailin Street	90	72	78	80
NV2	Sobolev Street	64	53	40	52
NV3	Main road	75	66	61	66
NV4	Guldala Mosque	64	48	37	49
NV5	Almerek Village	55	46	34	45
NV6	Airport entrance booths	75	59	59	63
NV7	Airside	74	62	46	61
NV8	Airside by existing terminal	76	61	49	62

[15] BTEX monitoring was undertaken during the following periods: Period 1- 27/01/21-11/02/21, period 2- 11/02/21-24/02/21, period 3- 24/02/21-11/03/21

[16] NO_2 monitoring was undertaken during the following periods: Period 1- 27/01/21-17/02/21, period 2- 17/02/21-11/03/21, period 3- 11/03/21-31/03/21

Note: Site IDs 6, 7 and 8 are located within/adjacent the SPZ. * Refers to NO_2/VOC monitoring location.

5.3.9 Table 5.15 presents the period mean of monitored pollutant concentrations across the six weeks of VOC monitoring for all of the monitoring locations, which was derived using three separate sets of diffusion tubes. As with NO_2, the averaged data cannot be directly compared with national air quality standards; however, based on the data below it was likely that the national requirements were being met. In addition, with the exception of benzene, applicable international standards (see Table 5.2) for annual mean concentrations of toluene, ethylbenzene and xylene appeared to be indicatively met.

Table 5.15: Monitored VOC concentrations (µg/m^3)

Site ID	Location	Average of six-week monitoring period between January and March 2021			
		Benzene	Toluene	Ethyl Benzene	Xylene
NV1	Mailin Street	9.3	23.6	6.3	23.9
NV2	Sobolev Street	8.5	18.6	5.3	16.4
NV3	Main road	9.1	21.8	3.2	16.8
NV4	Guldala Mosque	7.3	11.1	1.8	8.4
NV5	Almerek Village	6.0	11.5	1.8	10.8
NV6	Airport entrance booths	12.0	32.1	7.1	29.0
NV7	Airside	7.1	17.3	4.5	14.2
NV8	Airside by existing terminal	7.4	16.9	3.1	13.0

Particulate monitoring

5.3.10 In addition, monitoring for particulate matter in the form of PM_{10} was also undertaken for the 2022 ESIA. The monitoring locations are presented in Figure 5.2, with monitoring site 1 located within the SPZ. Monitoring was undertaken at each location for a period of approximately 24 hours once a month for three months in December 2020, January 2021 and February 2022.

5.3.11 Monitored results show that PM_{10} concentrations were generally high and above the national daily standard of 60µg/m^3 in month 1 and month 2 whilst in month 3 concentrations were lower and either below the standard or much closer to it. Generally, concentrations of PM_{10} are much higher during the winter months compared to the summer months due to the seasonal weather conditions and the need for additional local fuel burning in people's homes. In addition, the location of the city and the common temperature inversions that are experienced means during the winter months dispersion of pollution is poor.

Table 5.16: Monitored PM_{10} concentrations (µg/m^3)

Location	Period 1 (December 2020)	Period 2 (January 2021)	Period 3 (February 2021)
PM monitoring site 1 (PM1)	896	40	16
PM monitoring site 2 (PM2)	290	212	70
PM monitoring site 3 (PM3)	1127	205	56

Airport Operation monitoring – August 2024

5.3.12 As part of Almaty Airport's requirement to undertake an annual cycle of air quality measurements at the SPZ boundary, concentrations of pollutants including NO_2, PM_{10}, $PM_{2.5}$ and VOCs were monitored on the 21st August 2024 at the same eight locations listed in Table 5.14 and Table 5.15. The monitoring period and equipment used is unknown, but it is assumed that the ambient monitoring results are spot samples and cannot be directly compared to the relevant air quality standards.

5.3.13 Table 5.17 presents the monitored pollutant concentrations for the eight monitoring locations for NO_2. The highest concentrations were monitored along the Mailin Street (which is the main access route to and from the airport and is heavily influenced by road traffic) and within the airport by the existing terminal (within the SPZ).

5.3.14 VOC monitoring indicates that BTEX pollutants are well below the applicable national standards.

Table 5.17: Monitored NO_2, PM_{10}, $PM_{2.5}$ and VOC concentrations (µg/m³)

Site ID	Location	NO_2	PM_{10}	$PM_{2.5}$	Benzene	Toluene	P-Xylene	M-Xylene	O-Xylene
NV1 / PM2	Mailin Street	77	10	11	4.4	<0.1	<0.1	<0.1	<0.1
NV2	Sobolev Street	102	-	-	<1	3.1	<0.1	<0.1	<0.1
NV3	Main road	116	-	-	3.6	2.1	<0.1	<0.1	<0.1
NV4/ PM3	Guldala Mosque	100	82	41	2.8	5	<0.1	<0.1	<0.1
NV5	Almerek Village	104	-	-	<0.1	<0.1	<0.1	<0.1	<0.1
NV6	Airport entrance booths	109	-	-	7.1	4.7	<0.1	<0.1	1
NV7	Airside	78	-	-	2	4.2	<0.1	<0.1	1.3
NV8/ PM1	Airside by existing terminal	115	54	22	2.6	5.3	<0.1	<0.1	2.1

Note: <0.1 means less than 0.1.

Summary

5.3.15 In summary, the existing air quality monitoring data indicates that NO_2 concentrations are generally high both near to and within the airport boundary. In contrast, VOC concentrations are generally low whilst PM concentrations fluctuate with seasonal changes.

Future baseline

5.3.16 Baseline concentrations of transport related air pollutants are expected to decline in future years due to newer less polluting cars entering the fleet and as a result of other potential improvements in emission sources across the city. Improvements in vehicle emissions are expected following the implementation of more stringent Euro emission standards within Kazakhstan which is likely to offset the increase in traffic associated with the Project. Therefore, it is likely that in the future overall pollutant concentrations may be lower than current levels.

5.3.17 Nonetheless, there is uncertainty surrounding the level of improvement in vehicle emissions and future electric car uptake. As such, in order to determine future concentrations for the assessment of road traffic impacts on air quality, it has been conservatively assumed that there is no change in future baseline concentrations.

5.4 Potential impacts

5.4.1 Potential air quality impacts from the Project include:

- Construction dust within 500m of construction activities
- Increase in concentrations of NO_2, PM_{10} and $PM_{2.5}$ are anticipated within 200m of Mailin Street during the operational phase. These increases are attributable to a projected increase in passenger numbers accessing the airport via Mailin Road.
- Increase in ground level NO_2 and VOC concentrations caused by intensification of airside operations including a projected increase in LTO and associated GSE.

5.5 Assessment of effects

Construction phase effects

Construction activities and associated impact magnitude

5.5.1 The construction phase is expected to last for approximately two and a half years between 2025 and 2028, and will consist of major construction works.

5.5.2 At this stage, there is no formal construction plan available as the final construction arrangements have not been agreed. However, based on previous project experience and the data available, the following construction activities have been assumed. Based on these activities, the dust raising potential and overall impact magnitude are presented in Table 5.18.

Table 5.18: Construction activities and associated impact magnitude

Section	Description of works	Potential key activities	Dust raising potential	Duration	Impact magnitude
Demolition	Demolition of existing runway, pavement	Mechanical demolition, mobile crushing	High	>3 months	Major
Groundworks and foundations	Excavation, soil handling, drilling, digging, concrete activities, landscaping	Earthmoving, excavation	High	>3 months	Major
Storage of materials onsite	Stockpiling of materials on site	Unloading, moving and loading of materials	High	>3 months	Major
Transport of materials within site	Movement of construction materials, fill and waste materials around the site	Construction material moving, re-suspension of dust	Medium	>3 months	Moderate
Transport of materials offsite	Delivery of materials to site and removal of wastes from site	Transport of materials, re-suspension of dust	Low	>3 months	Negligible
Construction of airport facilities	Construction of new in-flight catering facility, new parallel taxiway, de-icing apron, VIP apron, cargo	Concrete batching, sandblasting, asphalt paving, material cutting	High	>3 months	Major

Section	Description of works	Potential key activities	Dust raising potential	Duration	Impact magnitude
	apron, runway, stand positions rehabilitation. Upgrade of existing fuel farm.				

5.5.3 The activities associated with the construction phase of the Project are conservatively assumed to have a 'high' dust raising potential throughout the whole construction period. Taking the dust raising potential and the duration of the works into account, the **magnitude** of dust effects is considered to be '**major'**.

5.5.4 As described in previous sections, consideration has been given to all potential receptors within the study area of the construction site boundary of the Project. In accordance with Table 5.10, the receptor **sensitivity** is classed as '**high'** based on the presence of aircraft and high-density urban areas including a children's playground within 50m of construction activities.

5.5.5 In accordance with the **significance** criteria presented in **ESIA Chapter 4: ESIA scope and methodology**, the risk of dust effects during the construction phase is described as **'major adverse'**. To reduce this effect, good practice dust control measures have been presented among the mitigation measures.

Operational phase effects

Landside

5.5.6 The operation assessment has been undertaken for a future year of 2030. The assessment is based upon predicted passenger numbers of 16,000,000 in 2030 which is an increase of approximately 3,700,000 from 2025. Table 5.19 to Table 5.21 present the changes in predicted concentrations at the likely worst affected receptor (closest to the road) along Mailin Street in 2030.

5.5.7 It has been conservatively assumed that all of the increase in passenger numbers and the associated vehicle movements to and from the airport is due to the Project. This is likely to be an overestimate as passenger numbers and vehicle movements would still increase at the airport without the Project. Therefore, the incremental increase caused by the Project would be less than has been assumed here. The assessment has also assumed that there would be no reduction in background pollutant levels in 2030 compared to 2021.

5.5.8 The receptor **sensitivity** is considered '**high'** as it has conservatively been assumed that concentrations of NO_2 would still exceed national air quality standards in 2030 and the airshed is 'degraded', as per the definition within the WBG EHS Guidelines[17]. The current baseline monitoring indicates that NO_2 concentrations are already high (80µg/m^3)[18] along Mailin Street and well above 24-hour national air quality standard and the annual mean international air quality standards.

5.5.9 Table 5.19 presents the predicted without and with Project NO_2 concentrations for 2030 along with the incremental impact from the increased traffic associated with the Project. The results

[17] The General EHS Guidelines[4] states that "An airshed should be considered as having poor air quality if nationally legislated air quality standards or WHO Air Quality Guidelines are exceeded significantly."

[18] Based on the data collected it can be observed concentrations reduce in summer months compared to winter months

show that the increase in traffic due to increased passenger numbers at the airport is predicted to lead to an incremental NO_2 increase of 2.8μg/m^3.

5.5.10 The predicted concentrations both without and with the Project in 2030 are lower than the 2021 baseline as the increase in traffic would be offset by a reduction in emission factors associated with less polluting vehicles entering the fleet. In addition, it is expected that the improvements in vehicle emissions, alongside other potential reductions in emissions across the city, may also lead to a reduction in future background pollutant concentrations and therefore it is likely that future pollutant concentrations will be lower than current monitored levels. In accordance with the significance criteria adopted for this assessment, the effects on sensitive receptors from NO_2 are conservatively described as '**moderate adverse'**. Mitigation is provided in Section 5.6.

5.5.11 Table 5.20 and Table 5.21 present the incremental impacts of PM_{10} and $PM_{2.5}$ from the increased traffic associated with the Project. Like NO_2, the predicted increases in PM_{10} and $PM_{2.5}$ concentrations are likely to be an overestimate, due to the conservative assumptions described above. Nonetheless, the incremental impacts are less than 5% of the international annual mean standards and are therefore considered to be '**negligible'**. Although baseline concentrations of PM_{10} and $PM_{2.5}$ fluctuate with seasonal changes, the incremental impact from the Project is described as **not significant**.

Table 5.19: Predicted NO_2 annual mean pollutant concentrations (μg/m^3)

Location	Current baseline	2030 without Project	2030 with Project	Incremental impact	Change %	Impact magnitude	Receptor sensitivity	Evaluation of effects	Significance of effects
Mailin Street	78.4	61.6	64.4	2.8	14.0	Minor	High	Moderate	Significant

Notes: % change calculated based on international annual mean standard of 20μg/m^3.

Table 5.20: Predicted PM_{10} annual mean pollutant concentrations (μg/m^3)

Location	Incremental impact	Change %	Impact magnitude	Receptor sensitivity	Evaluation of effects	Significance of effects
Mailin Street	0.6	3.0	Negligible	High	Negligible	Not significant

Notes: % change calculated based on national annual mean standard of 20μg/m^3.

Table 5.21: Predicted $PM_{2.5}$ annual mean pollutant concentrations (μg/m^3)

Location	Incremental impact	Change %	Impact magnitude	Receptor sensitivity	Evaluation of effects	Significance of effects
Mailin Street	0.3	3.3	Negligible	High	Negligible	Not significant

Notes: % change calculated based on national annual mean standard of 10μg/m^3.

Airside

5.5.12 LTO data from the Traffic Advisor[19] indicates that the Almaty International Airport (ALA) is expected to increase the number of passengers and ATMs. Whilst the Project is not directly responsible for the increase in passenger numbers and cargo traffic, the Project will increase the airport's capacity and therefore its ability to handle increasing ATMs and deliver on its ambition of being a regional hub airport.

5.5.13 Whilst ATM movements will increase, it should be noted that movements only have an impact on ground level air quality when an aircraft altitude is below 915m and therefore the key receptors are those located near to the airport itself. Considering the existing ambient NO_2 concentrations at these closest receptors, which is already above national air quality standards, the increase in ATMs has the potential to further increase concentrations. However, the additional contributions from increases in aircraft movements at nearby receptors is likely to be small and not significant when compared to the other main sources of air pollution in Almaty. This is demonstrated by the baseline monitoring data undertaken in 2021 which indicates that concentrations in Almerek (monitor NV5), the village located to the north-east of the runways has the lowest monitored concentrations of NO_2, and Guldala, located to the south-east of the runways has the second lowest monitored concentrations of NO_2.

5.5.14 In addition, the 2021 ambient air quality monitoring (presented in Table 5.14) indicates concentrations of NO_2 are approximately 10 to 15µg/m^3 higher within the airfield than at surrounding villages. This indicates that the impacts on air quality from airfield activities and the LTO cycle are highest close to where these activities take place, and concentrations quickly reduce with distance from the source. This supports the conclusion that increases in LTO cycles and GSEs will not have a significant effect on pollutant concentrations in nearby villages.

5.5.15 Table 5.22 presents the total projected NO_x mass emissions from ATMs (LTO cycle) and GSE on an annual basis in the base year of 2025 and a future year of 2030. Chart 5.1 presents the projected increase in NO_x emissions between 2025 and 2030, including the split between GSE and ATM.

5.5.16 Table 5.22 indicates that between 2025 and 2030, NOx emissions are predicted to increase by approximately 27%. This increase is predominantly accounted for by ATMs, as illustrated in Chart 5.1. In contrast, GSEs contribute only a minimal proportion of the total emissions.

5.5.17 Overall, the **magnitude** of effects on receptors outside the airport perimeter is considered '**negligible'** as increased airport activity is only expected to contribute a small incremental increase at receptor locations. The receptor **sensitivity** is considered '**high'** as it has conservatively been assumed that concentrations of NO_2 would still exceed national air quality standards in 2030 and the airshed is 'degraded', as per the definition within the WBG EHS Guidelines[17]. Therefore, in accordance with the **significance** criteria set out in **ESIA Chapter 4: ESIA scope and methodology**, the effects on sensitive receptors from NO_2 are described as '**negligible'**.

5.5.18 It is recommended that as part of the operational mitigation of the airport an emissions inventory and emissions control plan should be developed to further understand and mitigate future emissions where possible. Section 5.6 provides examples of mitigation measures for inclusion across a ten-year horizon.

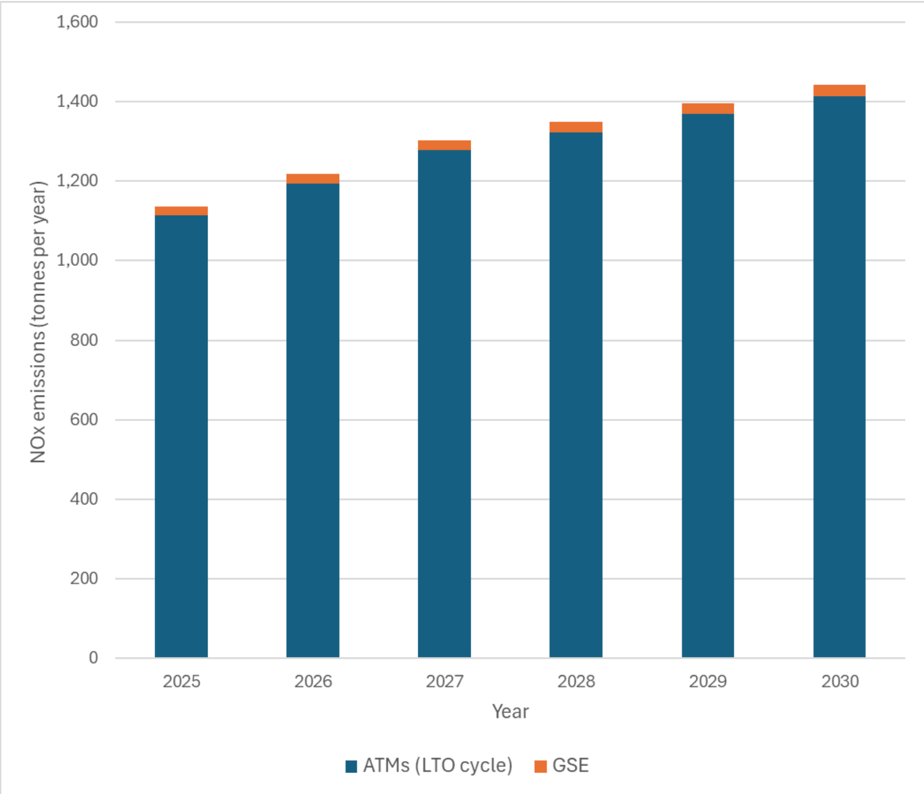
[19] Mott MacDonald (2025). Project Horizon Traffic Advisor in relation to the new Investment plan of Almaty International Airport in Kazakhstan, Traffic Forecasts Outputs (Base, Low, Climate) - DRAFT (NON-RELIANCE BASIS), Version 6.0, 29 July 2025.

Table 5.22: Projected NO_2 emissions from LTOs and GSE (tonnes per year)

Source	Current baseline (2025)	2030 with Project	Change %
Ground Support Equipment	23	28	22
Landing Take-Off	1,113	1,413	27

Source: Air Traffic Forecast (Mott MacDonald, 2025)

Chart 5.1: LTO and GSE mass emission projection between 2025 and 2030 (tonnes per year)



Source: Air Traffic Forecast (Mott MacDonald 2025)

Operational impacts and effects – occupational health

5.5.19 Ambient monitoring presented in Section 5.3, demonstrates that existing pollutant concentrations of NO_2 and VOCs, which are the main pollutants associated with airport operations, are well below relevant air quality standards set for occupational exposure and therefore **sensitivity** is described as '**negligible'** as they are judged to be below 50% of the relevant standard even when accounting for differences in averaging periods of the monitoring and the standards.

5.5.20 The future contributions to NO_2 and VOC concentrations associated with the increased number of LTOs and GSEs are not anticipated to result in significant increases in pollutant concentrations within the airport perimeter. Even if it was conservatively assumed that the increase in airport activity contributed to a doubling of VOC and NO_2 concentrations, these increases would still likely be below 5% of the relevant standard (noting that monitoring undertaken for the Project is long term averages and occupation standards are for 15 minute and 8 hour averaging periods). Therefore, the **magnitude** of change is considered '**negligible'**.

5.5.21 In accordance with the **significance** criteria set out in **ESIA Chapter 4: ESIA scope and methodology**, the effects on occupational health from NO_2 and VOCs are described as **'negligible'** and **not significant**.

5.6 Mitigation

5.6.1 Mitigation measures to manage potential air quality impacts during construction and operation of the Project are already being implemented as part of the air quality management plan (within the wider Environmental and Social Management Plan (ESMP)) produced for the Almaty Airport Expansion in 2022. The same mitigation measures are applicable to this Project and are in alignment with the IFC EHS guidelines. The mitigation measures that are being implemented will control the following emission sources within and in the vicinity of the airport boundary (and SPZ):

- Dust emissions during construction
- Emissions from mobile sources and any generators during operation and construction
- Emissions associated with increased road and air traffic movements during operation

5.6.2 The 2022 ESMP also includes a requirement for ambient air quality monitoring, which is currently being undertaken through quarterly surveys. However, the monitoring programme should be strengthened by increasing the frequency of sampling and improving sampling methods. With particular relevance to Mailin Street, ambient NO_2 monitoring should be undertaken to track trends in concentrations and assess compliance with national air quality standards.

5.6.3 Daily visual inspections will be undertaken at construction areas across the site by a suitably qualified/experienced member of the construction team throughout the construction phase to monitor the implementation and effectiveness of prescribed mitigation measures. ALA will be responsible for ensuring that all contractors implement the mitigation measures during the construction of the Project.

5.6.4 In addition, the IFC General EHS Guidelines provide recommended prevention and control techniques for fugitive emissions, which should be implemented to control fugitive emissions associated with the operation of the fuel farm. Examples of techniques include:

- Monitoring of VOCs around the fuel farm
- Modifying equipment e.g. using a closed-vent system for any compressors and a seal-less design in values and pumps
- Implementing a leak detection and repair (LDAR) program that controls fugitive emissions by regularly monitoring to detect leaks, and implementing repairs within a predefined time period

5.7 Summary of residual effects

Residual effects after the application of mitigation are presented in Table 5.23. Following application of mitigation all effects are considered not significant with the exception of the increase in pollutant concentrations at receptors adjacent to Mailin Street as a result of increased traffic. This is primarily as the effects of the proposed mitigation to reduce emissions associated with travel to and from the airport cannot be quantified at this stage due to uncertainties associated with future electric car uptake.

Table 5.23: Summary of residual effects for air quality

Description of effect	Permanent or temporary	Sensitivity of receptor	Magnitude of impact	Significance of effect before additional mitigation	Additional mitigation	Residual effect	Proposed monitoring
Construction phase							
Dust nuisance from construction activities on sensitive receptors located within 500m	Temporary	High	Major	Major adverse (Significant)	The following measures should continue to be implemented which are already being implemented as part of the 2022 ESMP / air quality management plan: ● Minimising dust from material handling sources, such as conveyors and bins, by using covers and/or control equipment such as water suppressors ● Minimising dust from open area sources, including storage piles, by using control measures such as installing enclosures and covers, and increasing the moisture content ● Implementing dust suppression techniques on unpaved roads, such as applying water or non-toxic chemicals to minimize dust from vehicle movements ● No bonfires and burning of waste materials shall be allowed ● Planning land clearing, removal of topsoil and excess materials, location of haul roads, tips and stockpiles with due consideration to meteorological factors (e.g. precipitation, temperature, wind direction, and speed) and location of sensitive receptors ● Designing, installing and applying a simple, linear layout for materials-handling operations to reduce the need for multiple transfer points ● Compacting and periodically grading and maintaining roads within the airport boundary ● Vegetating exposed surfaces of stockpiled materials. ● Managing the blending, packing, loading, unloading of bulk cement, aggregates, bitumen and filler materials for batching plants, if required for construction, by:	Negligible	Monitor dust by undertaking daily on-site and off-site visual inspections where receptors are nearby. This should include regular dust soiling checks of surfaces at sensitive receptor locations within 100m of site boundary. Increase the frequency of inspections when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions. A record of visual inspections, including the results, should be kept and dust control methods and implementation reviewed where

Description of effect	Permanent or temporary	Sensitivity of receptor	Magnitude of impact	Significance of effect before additional mitigation	Additional mitigation	Residual effect	Proposed monitoring
					– Containing dusty processes: containment and arrestment are the preferred option for control of emissions to air from processes handling cement and asphalt – Suppressing dust using water or proprietary suppressants. Where water is used for dust suppression, processes require an adequate supply of water. To demonstrate an adequate water supply on tanks, a low-level alarm will be fitted. – Protecting external sources, such as stockpiles and external conveyors, from wind whipping is necessary. There are various methods that may be used to this end. Crushed rock, sand or coarse aggregate, can be delivered, stored and handled so as to minimise dust emissions, for example by dampening or covering. – Plan site layout so that batching plant, including materials handling and stockpiling, are located away from sensitive receptors, as far as is possible.		excessive dust soiling is recorded.
Emissions management from mobile sources (on-road, off-road vehicles and mobile crushers)	Temporary	High	Negligible	Negligible	The following measures should continue to be implemented which are already being implemented as part of the 2022 ESMP / air quality management plan: ● Regardless of the size or type of vehicle, owners / operators will implement the manufacturer recommended engine maintenance programmes ● Enforce a speed limit for Heavy Goods Vehicles (HGVs) on-site at 20km per hour ● Drivers will be instructed on the benefits of driving practices that reduced both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits ● Enforce a ‘no-idling’ policy ● Old construction vehicles will be replaced with newer more fuel-efficient alternatives where possible ● Convert high use vehicles to cleaner fuels where possible	Negligible	None

Description of effect	Permanent or temporary	Sensitivity of receptor	Magnitude of impact	Significance of effect before additional mitigation	Additional mitigation	Residual effect	Proposed monitoring
					● Install and maintain emission control devices such as catalytic convertors ● Implement a regular vehicle maintenance and repair programme		
Emissions management for generators	Temporary	High	Negligible	Negligible	With regards to any generators used on site: ● Consider the location and height of exhaust pipes to ensure proper dispersion of pollutants. ● Use generators of a modern design and keep them well-maintained following original equipment manufacturer (OEM) maintenance schedule.	Negligible	
Operational phase – public health							
Increased pollutant concentrations as a result of emissions from operation traffic (both air and road) on receptors adjacent to Mailin Street	Permanent	High	Minor	Moderate adverse (Significant)	The following measure, already included in the 2022 ESMP, should continue to be implemented but not be limited to: ● Develop an operational traffic management strategy to reduce emissions from passenger and staff transport. This should include: – Infrastructure for electric vehicles, such as charging stations, to support the transition to low-emission cars and buses. – Staff travel plans that encourage carpooling and other sustainable commuting options.	Moderate adverse (Significant)	Increase frequency and improve methods of ambient air quality monitoring, particularly for NO_2 at Mailin Street. Conduct monthly monitoring to track trends and compare with national standards.
Increased pollutant concentrations as a result of emissions from increased airport operations on receptors	Permanent	High	Negligible	Negligible	The following measure, already included in the 2022 ESMP, should continue to be implemented: ● An emissions control plan should be developed setting out how the airport will reduce emissions associated with increased ATMs in future years. ● As a minimum this should require a detailed emission inventory to be developed setting out current emissions for the year it is compiled and be broken down to ATMs, APUs and GSEs.	Negligible	As above

Description of effect	Permanent or temporary	Sensitivity of receptor	Magnitude of impact	Significance of effect before additional mitigation	Additional mitigation	Residual effect	Proposed monitoring
located in nearby villages					• The plan should set out measures that the airport will implement to reduce emissions and should include, as a minimum: – Limited run times on APUs – Provision of airside electric charging to facilitate transition to electric GSEs – Requirement of reduced thrust take offs, where applicable – Reduced engine run taxiing – Optimisation of service infrastructure to reduced aircraft and ground vehicle movements – Selecting cleaner fuels for firefighting drills – Set out a clearly defined air quality monitoring plan to monitor air quality impacts and effectiveness of emission control measures – Provision of landside charging infrastructure to promote the use of electric transport provision		
Risk of increased emissions from fuel farm operations on receptors located in nearby villages	Permanent	High	Negligible	Negligible	Update the air quality management plan to include prevention and control measures for fugitive emissions from fuel farm operations. Measures should include: – Monitoring of VOCs around the fuel farm – Equipment modifications to reduce emissions – Implementation of a LDAR program	Negligible	Monitoring of VOCs around the fuel farm
Operational phase – occupational health							
Increased emissions from airport activities on airport workers	Permanent	Negligible	Negligible	Negligible	None	Negligible	None

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