

Ok Birim Tailings Storage Facility Project

Environmental and Social Impact Assessment

Appendix H

Air quality assessment and greenhouse gas emissions assessment report



AIR QUALITY AND GREENHOUSE GAS IMPACT ASSESSMENT

**OK BIRIM TAILINGS STORAGE FACILITY PROJECT
OK TEDI MINING LIMITED – WESTERN PROVINCE, PAPUA NEW GUINEA**

06/07/2026

EXECUTIVE SUMMARY

Purpose and Scope

This report presents an air quality and greenhouse gas (GHG) assessment for the proposed Ok Birim TSF Project in Western Province, Papua New Guinea. The assessment supports environmental approval processes and informs project design, construction planning and operational management. The Project includes a disturbance footprint of approximately 1,900 ha, an 87-km tailings delivery pipeline and access corridor, and TSF operations supported by on-site diesel power generation with up to ~11 MW installed capacity.

Assessment Framework

The assessment applies a tiered approach that combines:

- (i) quantitative dispersion modelling (AERMOD) to predict ground-level concentrations of particulate matter and combustion pollutants at sensitive receptors; and
- (ii) a qualitative, risk-based construction dust assessment using IAQM guidance to evaluate potential dust effects and mitigation requirements.

In the absence of Papua New Guinea statutory ambient standards, adopted criteria are based primarily on EPA NAAQS standards and WHO Air Quality Guidelines (2021) for health-based pollutants, supplemented by legacy EPA TSP values for nuisance/amenity context.

The air quality assessment has been focused on particulate matter (TSP, PM₁₀, PM_{2.5}) and nitrogen dioxide (NO₂) as these pollutants represent the most relevant indicators of potential impacts associated with the Project's emission sources. Particulate matter is the primary pollutant associated with construction-related activities, including earthworks, material handling, and unsealed road traffic, and therefore governs short-term amenity and health considerations. During operations, emissions are dominated by diesel combustion from on-site power generation, for which NO₂ is the key pollutant of concern for both short-term and long-term exposure.

Other pollutants such as carbon monoxide (CO) and sulfur dioxide (SO₂) were evaluated as part of the emissions inventory and screening assessment. These pollutants are generated in small quantities compared to particulate matter and NO_x, and predicted concentrations are low in absolute terms and well below the adopted ambient air quality criteria. Accordingly, they do not represent limiting factors in the assessment, and the evaluation focuses on the pollutants most relevant to potential impacts.

Receiving Environment and Sensitive Receptors

The Project is located in a remote tropical environment with high rainfall (~4,000–10,000 mm/year), high humidity, and generally low baseline pollutant concentrations, which inherently suppress dust generation. Sensitive receptors include villages within approximately 1–10 km of the TSF and along the infrastructure corridor, with some receptors located in close proximity to construction activities.

Key Air Quality Findings

Construction phase – Infrastructure corridor development area (pipeline and access road):

Pipeline construction represents the highest short-term air quality impact scenario, driven by the linear nature of works and close receptor proximity.

- Maximum predicted concentrations occur under near-field conditions (<10 m), but remain well below adopted criteria.

- IAQM classification indicates:
 - **High unmitigated dust risk,**
 - **Low–Medium residual risk with mitigation,** reflecting localized and short-term impacts.

Impacts are therefore transient and manageable, driven by dust rather than combustion emissions.

Construction phase – TSF:

TSF construction involves large-scale earthworks over a fixed footprint.

- Emissions are spatially distributed, resulting in lower modeled concentrations than pipeline construction, despite higher total emission magnitude.
- IAQM classification indicates:
 - High unmitigated dust risk,
 - Low–Medium residual risk with mitigation, reflecting localized and short-term impacts.

Impacts are temporary, localized, and controlled through standard mitigation measures.

Operations phase – TSF:

Operational emissions are governed by diesel combustion rather than dust.

- Particulate matter concentrations are an order of magnitude lower than construction and well below criteria.
- NO₂ is identified as the governing pollutant, driven by continuous diesel power generation.

Model results show:

- Annual NO₂ concentrations of approximately 5.05 µg/m³, below the adopted EPA guideline (100 µg/m³).
- 1-hour NO₂ concentrations (~112.3 µg/m³) remain below reference criteria.

Operational impacts are therefore persistent but within applicable air quality criteria.

Criteria Comparison (Worst-case Modelled Concentrations)

The table below summarizes worst-case predicted concentrations across assessed scenarios and compares them to adopted ambient criteria.

Table 1 Summary of worst-case predicted ambient air quality concentrations and comparison with adopted criteria

Pollutant	Averaging period	Worst-case predicted (µg/m ³)	Adopted criterion (µg/m ³)	Result
TSP	24-hour	1.48	150	Below criterion
TSP	Annual	0.32	75	Below criterion
PM₁₀	24-hour	1.48	45	Below criterion
PM₁₀	Annual	0.32	15	Below criterion
PM_{2.5}	24-hour	1.44	15	Below criterion
PM_{2.5}	Annual	0.31	5	Below criterion
NO₂	Annual	5.05	100	Below criterion

Pollutant	Averaging period	Worst-case predicted ($\mu\text{g}/\text{m}^3$)	Adopted criterion ($\mu\text{g}/\text{m}^3$)	Result
NO ₂	1-hour	112.3	188	Below criterion

Dust Deposition

Dust deposition was evaluated using a screening-level approach based on modeled concentrations.

Predicted deposition rates:

- Infrastructure corridor construction (maximum): $9.35 \times 10^{-1} \text{ g}/\text{m}^2/\text{month}$
- Operations: $3.89 \times 10^{-4} \text{ g}/\text{m}^2/\text{month}$
- TSF construction: $1.82 \times 10^{-1} \text{ g}/\text{m}^2/\text{month}$

These values are:

- Substantially below the adopted criteria of $2 \text{ g}/\text{m}^2/\text{month}$ (incremental) and $4 \text{ g}/\text{m}^2/\text{month}$ (total),

This demonstrates that the Project will not result in measurable dust deposition impacts at surrounding receptors.

Greenhouse Gas (Scope 1) – Summary

Total Scope 1 emissions associated with the Project are approximately:

- 1,031,020 tCO₂e total, including:
- 1,000,350 tCO₂e from vegetation clearing
- 30,670 tCO₂e from construction combustion
- 44,793 tCO₂e/year during operations

Vegetation clearing accounts for >97% of construction emissions (one-time event). Operational emissions are dominated by diesel power generation (~68%), typical of remote mining projects.

Annual operational emissions represent a small fraction of PNG national emissions and are not expected to materially affect national targets.

Overall Conclusion

The assessment demonstrates that:

- Construction-phase impacts are dominated by fugitive dust, with:
 - High unmitigated risk
 - Low–Medium residual impacts that are temporary, localized, and manageable
- Operational-phase impacts are governed by NO_x emissions, with:
 - Persistent but below-criteria NO₂ concentrations
 - No predicted exceedances of health-based guidelines
- Dust deposition impacts are negligible and significantly below assessment criteria
- GHG emissions are dominated by one-time vegetation clearing and ongoing diesel combustion, consistent with large-scale mining developments.
- Project-related annual emissions represent approximately 1% of Papua New Guinea's annual GHG emissions, which are on the order of several thousand kilotonnes CO₂e per year.

Overall, the Project is not expected to result in significant adverse air quality impacts at sensitive receptors and aligns with international good practice for environmental impact assessment and, the Project is not expected to materially influence national emissions trends or compromise Papua New Guinea's climate commitments.

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1. INTRODUCTION

1.1 PURPOSE OF THIS REPORT

This report presents the Air Quality and Greenhouse Gas (GHG) Assessment for the proposed Ok Birim Tailings Storage Facility (TSF) Project, to be developed by Ok Tedi Mining Limited (OTML) in Western Province, Papua New Guinea. The assessment has been prepared to support environmental approval processes and to inform project design, construction planning, and operational management.

The objective of the report is to identify and evaluate potential air quality and GHG impacts associated with the construction and operation of the TSF and associated infrastructure, including the tailings delivery pipeline and access roads, and to assess these impacts against relevant international standards and good practice guidance.

1.2 SCOPE OF THE ASSESSMENT

The assessment considers air emissions generated during the following project phases:

- Construction of the TSF;
- Construction of the tailings delivery pipeline and access roads; and
- Operation of the TSF, including on-site power generation.

The scope includes evaluation of:

- Fugitive dust emissions (Total Suspended Particulates (TSP), particulate matter at 10 and 2.5 micrometers in diameter PM_{10} and $PM_{2.5}$) arising from earthworks, material handling, unsealed roads, and wind erosion;
- Combustion emissions, particularly nitrogen oxides (NO_x , assessed primarily as NO_2), from mobile and stationary diesel-powered equipment;
- Identification and characterization of sensitive receptors potentially affected by emissions associated with the construction and operation of the TSF and related infrastructure, and; GHG emissions, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), generated from fuel combustion and vegetation clearing.

The assessment uses a combination of quantitative atmospheric dispersion modelling and qualitative risk-based assessment techniques, consistent with international good practice for large mining and infrastructure projects.

1.3 ASSESSMENT FRAMEWORK AND STANDARDS

In the absence of statutory ambient air quality standards in Papua New Guinea, the assessment adopts internationally recognised benchmarks and guidance, including:

- World Health Organization (WHO) Global Air Quality Guidelines (2021);
- International Finance Corporation (IFC) Environmental, Health, and Safety (EHS) Guidelines;
- Australian National Pollutant Inventory (NPI) Emissions Estimation Technique Manuals; and
- Institute of Air Quality Management (IAQM) Guidance on the Assessment of Dust from Demolition and Construction.

Quantitative dispersion modelling has been undertaken using the AERMOD regulatory model, while construction dust impacts are evaluated using the IAQM qualitative methodology, allowing each impact pathway to be assessed using appropriate and defensible tools.

1.4 STRUCTURE OF THE REPORT

This report is structured to describe the project, identify emission sources, define assessment criteria, characterise the existing environment, and evaluate potential impacts during construction and operation. Mitigation and residual risks are addressed through both quantitative modelling and qualitative assessment.

1.5 STRUCTURE OF THIS REPORT

Section 1 – Introduction and Structure of this Report

This section provides an overview of why the assessment was undertaken, what it covers, how it has been assessed, and how the report is organised.

Section 2 – Project Description

Describes the Ok Birim TSF Project, including its purpose, location, key components, development phases, and environmental and social context.

Section 3 – Project Activities and Associated Air Emissions Sources

Identifies construction and operational activities with the potential to generate air emissions, including earthworks, mobile and stationary combustion sources, and supporting infrastructure.

Section 4 – Assessment Approach

Describes the overall assessment methodology, including emission characterisation, dispersion modelling, and qualitative assessment approaches.

Section 5 – Impact Assessment Criteria

Describes applicable air quality and GHG criteria, relevant legislation and guidelines, and the international standards adopted for impact evaluation.

Section 6 – Existing Environment

Characterises the existing physical environment relevant to air quality, including climate, meteorology, land use, identified surrounding communities and sensitive receptors, and baseline air quality conditions for the TSF area and infrastructure corridor.

Section 7 – Impact Assessment Methods

Details the quantitative and qualitative methods used, including dispersion modelling tools, meteorological inputs, modelling assumptions, and the IAQM construction dust assessment framework.

Section 8 – Air Quality Impact Assessment

Presents the results of the quantitative modelling and qualitative assessment for particulate matter and NO_x during construction and operation, including comparison with assessment criteria and evaluation of impact significance.

Section 9 – Quantitative and Qualitative Assessments

Integrates dispersion modelling outcomes with the IAQM qualitative dust risk assessment to provide a coherent, phase-specific evaluation of air quality impacts and residual risks.

Section 10 – Greenhouse Gas Assessment

Quantifies GHG emissions associated with construction and operations, describes calculation methodologies, and presents emissions by source and scope.

Section 11 – Summary and Overall Assessment Statement

Summarises key findings, identifies governing pollutants by project phase, and presents the overall conclusions regarding air quality and GHG impacts.

Section 12 – References

Lists all regulatory guidance, standards, technical documents, and supporting information used in the assessment.

2. PROJECT DESCRIPTION

The project is in the northwestern corner of Western Province, south of the Central Cordillera Mountain range which runs east-west along the length of Papua New Guinea (PNG). The proposed tailings storage facility (TSF) is approximately 1 km west of the confluence of the Ok Birim and Ok Tedi, and about 55 km south of the existing Ok Tedi Mine (90 km by road via the Kiunga-Tabubil Highway). The mine lies approximately 5 km west of the Ok Tedi, a major tributary of the larger Fly River.

Based on the proposed project layout, the total disturbance footprint is estimated at approximately 1,900 ha. Project activities will primarily occur in the following two areas:

TSF development area (approximately 1,500 ha) – This includes the TSF footprint, hydro-cyclone house and ancillary infrastructure, surface water management facilities and internal roads and tracks. The area is within a lowland setting with regional topography gently sloping to the south. The TSF site is in a sub-catchment of the Ok Yep, to the west and south of Ok Birim and Ok Tedi confluence. The northern part of the TSF site is approximately 1 km west of this confluence. The TSF site is generally flat with undulated shallow valleys ranging in elevation from approximately 40 m to 80 m above mean sea level (AMSL).

Infrastructure corridor development area (approximately 400 ha) – This includes the proposed pipeline access road, bridges and water/ravine crossings, tailings pipeline and supporting facilities outside the TSF development area. The corridor area varies from the rugged, steep-sided valleys near the mine to the more gently undulating terrain and floodplains towards the TSF site.

Key components of the project are:

- A hydro-cyclone house for separating coarse and fine tailings, with coarse underflow used for embankment construction and fine overflow directed to the TSF impoundment.
- A ring-dyke TSF comprising internal storage cells developed progressively, with embankments primarily constructed using cyclone underflow sand.
- An 87-km-long tailings delivery pipeline from the existing TPP at Ok Tedi Mine to the proposed TSF site, including associated pumping and piping distribution systems (i.e., one pump station at the mine site and two intermediate choke/valve stations).
- A pipeline access road corridor including three bridges and several minor water/ravine crossings.
- Ancillary infrastructure including site offices, laydown areas, workshops, maintenance stations, waste and sewage management facilities, fuel storage, borrow and gravel pits and accommodation camps (as required).
- Power supply primarily from on-site diesel generators, with an installed capacity of up to 11 MW during operations.
- Water supply sourced primarily from existing mine site supply, TSF decant water during operations, supplemented by rainfall and potential abstraction from nearby watercourses or groundwater for construction and potable water (if required).

Table 2 provides a high-level summary of key project components.

Aspect	Description
TSF	
Tailings volume	Current TSF design provides storage for approximately 368 Mt of tailings material, with a maximum design storage capacity allowance of 263 million cubic meters (Mm ³).
Hydro-cyclone and TSF design and staging	<ul style="list-style-type: none"> Construction of the hydro-cyclone house is planned to separate the underflow (to be used for embankment construction) and overflow (to be deposited into the TSF impoundment). Decant water from the TSF will be re-used as process water via dedicated pumping and piping distribution infrastructure. TSF to be developed in stages, with two conceptually defined storage cells to be constructed, operated and closed consecutively. TSF starter embankment to use suitable borrow fill material sourced from bulk earthworks and local borrow and gravel pits along the Ok Tedi (subject to suitability testing). Embankments will then be primarily constructed using suitable cyclone underflow sand. Centerline-raised embankments of cyclone underflow primarily via hydraulic cell construction, compacted to the density specified in the design to retain cyclone overflow and uncycloned tailings. No permanent water cover is expected to be required for tailings in the TSF impoundment area as the tailings are non-acid forming based on current geochemical characterisation results. TSF ultimate embankments will reach a maximum height of 30 m with a final crest elevation of 80 m RL.
TSF water management	<ul style="list-style-type: none"> TSF lies entirely within the Ok Tedi catchment to minimise introducing new impacts to other catchments such as the Ok Birim, which remains unaffected by current mining activities. TSF has been positioned above the high banks of the Ok Birim and Ok Tedi to minimise flood interaction. Surface water diversions will be established to divert existing streams and clean surface water flows away from the TSF during all phases of the project. Sedimentation ponds will be constructed strategically to limit fugitive sediment. During operations, the TSF will operate as a flow-through system with excess decant water reporting to the Ok Tedi in a controlled manner via a siphon system. Each TSF cell will incorporate a siphon discharge system, associated pipelines and outlet, and emergency spillway to enable planned and emergency release of excess TSF decant water. Planned discharge of excess TSF decant water will flow to the Ok Tedi after reduction of suspended solids. Seepage collection at the south (downstream) of the TSF will be transferred to a sedimentation pond, while un-intercepted seepage is expected to report to the Ok Tedi.
Infrastructure corridor	
Access roads	Construction and upgrade of access roads/tracks, including an 87-km-long pipeline access road from the Ok Tedi Mine to the proposed TSF (comprising 22 km along the existing highway from the mine to Tabubil and 65 km of new road), three permanent bridges over the Ok Tedi, Ok Taub and Ok Birim, and several minor water/ravine crossings. Generally two-lane, unsealed roads with an all-weather road base, with single lane sections and passing bay areas where required. Gravel will be applied as needed for dust suppression, such as near villages. Single or two-lane bridges will be provided with dedicated pedestrian footpaths. A speed limit of 40 km/hr for internal roads/tracks and 65 km/hr for roads shared with the community with appropriate road safety signage where needed.
Tailings pipeline	Construction of 87-km-long pipeline to transport final tailings from the TPP at the Ok Tedi Mine to the proposed TSF. Approximately 80% buried and 20% above ground. Pipeline is expected to be constructed along the pipeline access road for the entire route.

2.1 ENVIRONMENTAL AND SOCIAL CONTEXT

The project is in the northwestern corner of Western Province, south of the Central Cordillera Mountain range which runs east-west along the length of Papua New Guinea (PNG). The proposed tailings storage facility (TSF) is approximately 1 km west of the confluence of the Ok Birim and Ok Tedi, and about 55 km south of the existing Ok Tedi Mine (90 km by road via the Kiunga-Tabubil Highway). The mine lies approximately 5 km west of the Ok Tedi, a major tributary of the larger Fly River.

The Ok Tedi Mine at Mt Fubilan is an open-cut copper, gold and silver mine owned and operated by OTML since 1984. Ore is mined and processed at an on-site processing plant capable of treating up to 24 million tonnes per annum of ore. Copper concentrate is transported via a 156-km-long pipeline to port facilities at Kiunga, where it is dried then shipped along the Fly River to Port Moresby for export. Pyrite concentrate produced at the tailings processing (TPP) near the mine is transported via a 125-km-long pipeline to subaqueous storage pits on the west bank at Bige, where it is kept permanently submerged to prevent oxidation and acid generation. Residue sand tailings from the TPP are discharged via a 1.5-km-long tailings river disposal pipeline to Ok Kumiup, which flows into the Ok Tedi via Harvey Creek. Waste rock is also disposed to the creek system at the mine. This material is then transported downstream and the coarser material settles in a dredged slot near Bige, where dredged material is hydraulically placed into engineered stockpiles on the east and west banks of the Ok Tedi, which joins the Fly River approximately 25 km downstream. For more than 40 years, the Ok Tedi Mine has practiced riverine disposal of tailings and waste rock to the Ok Tedi. Up until 2025, over 2 billion tonnes of mine-derived sediment had been added to the Ok Tedi and Fly River system.

OTML is currently progressing several planned developments aimed at improving long-term environmental performance and supporting potential mine life extension as part of its Growth 2050 strategy. Projected mine production to 2050 will generate additional tailings and waste rock, placing additional pressure on the downstream river system. OTML has therefore committed to largely eliminate the currently approved practice of riverine tailings disposal. The project involves storing tailings on land in an engineered TSF from 2030 to limit further additions of mine-derived sediment to the Ok Tedi and Fly River system, reduce downstream environmental and social impacts and support continued mine operations to 2050. It is intended to provide a technically proven, environmentally sound and economically viable alternative to the current riverine tailings disposal practice, aligned with contemporary standards and PNG's sustainability development goals.

An environmental and social impact assessment (ESIA) has been prepared for the project to meet the requirements of Ok Tedi Environment Management Act 2019 as well as align with the Department of Environment and Conservation Guideline for Conduct of Environmental Impact Assessment and Preparation of Environmental Impact Statement (DEC 2004); and follows good international industry practice including the International Finance Corporation Performance Standards (2012) and Equator Principles 4.

As a separate but related development, OTML is also designing and supervising construction of the 14.5 km Alice Pit–Border Post Road under the Infrastructure Tax Credit Scheme (ITCS). This road includes a planned bridge over the Ok Tedi to connect to the existing Kiunga-Tabubil Highway near Alice Pit and improve regional accessibility and cross-border connectivity at the Yetetkun PNG–Indonesia border post. The assessment, approval and construction of ITCS Road is separate to the project and this ESIA.

The ITCS Road will provide initial access to the TSF, and its final alignment is expected to be modified as required over the project life to accommodate the staged development of the TSF.

3. PROJECT ACTIVITIES AND ASSOCIATED AIR EMISSION SOURCES

This section identifies and describes the key project activities with the potential to generate air emissions during both the construction and operational phases of the project, and defines the associated emission sources and pollutants. Air emissions are primarily generated from mobile and stationary combustion sources, earthworks and material handling activities, fugitive dust generation, and a range of ancillary activities. Table 3 summarizes the project components, phases, activities, and associated air emission types, while the sections below provide the technical basis for the emissions inventory and subsequent air quality impact assessment.

Table 3 Summary of Project Components, Phases, Activities, and Associated Air Emission Types.

Project Component	Construction	Operation	• Closure and Rehabilitation Phase
Tailings Storage Facility (TSF)	<ul style="list-style-type: none"> Site clearing, grubbing, and topsoil stripping: Fugitive particulate matter (TSP, PM₁₀, PM_{2.5}) from vegetation removal and exposed soils; combustion emissions (NO_x, CO, CO₂, SO₂, PM, VOCs) from clearing equipment; minor VOC emissions from decomposition of organic matter. Bulk earthworks (excavation, grading, leveling, embankment preparation) using excavators, dozers, and dump trucks: Fugitive particulate matter (TSP, PM₁₀, PM_{2.5}) from soil disturbance; Products of combustion (NO_x, CO, CO₂, SO₂, PM, VOCs) from diesel-powered equipment. Borrow and gravel extraction from the Ok Tedi and local borrow pits: Fugitive dust from excavation, handling, loading, and hauling; Combustion emissions (NO_x, CO, CO₂, SO₂, PM, VOCs) from excavation and haulage equipment. Starter dam and TSF embankment construction (fill placement, compaction, shaping): Fugitive particulate matter from placement and compaction of fill materials; Combustion emissions (NO_x, CO, CO₂, SO₂, PM, VOCs) from construction equipment. Hydro-cyclone house construction (structural works, installation activities): Fugitive dust from construction materials handling; Combustion emissions (NO_x, CO, CO₂, SO₂, PM, VOCs) from equipment and generators. Construction of surface water management infrastructure (drains, sedimentation ponds): Fugitive dust from excavation and earthworks; Combustion emissions from construction equipment. Establishment of construction camps, laydown areas, and workshops: Combustion emissions (NO_x, CO, CO₂, SO₂, PM, VOCs) from diesel generators and vehicles; VOC emissions from fuel storage and handling; Minor particulate emissions from site activity and material handling. Transport of construction materials and workforce (truck traffic, buses); Combustion emissions (NO_x, CO, CO₂, SO₂, PM, VOCs); Fugitive dust from unpaved road travel. 	<ul style="list-style-type: none"> Continuous tailings deposition into TSF impoundment as slurry discharge: Minor particulate emissions from drying surfaces (TSP, PM₁₀); Potential release of fine particulates during deposition and surface disturbance. Operation of diesel power generation (~up to 11 MW capacity): Combustion emissions (NO_x, CO, CO₂, SO₂, PM_{2.5}, PM₁₀, VOCs). TSF embankment raising and ongoing earthworks (staged development): Fugitive dust from various material handling; Combustion emissions from mobile equipment. Routine inspection, maintenance, and repair using mobile equipment: Combustion emissions (NO_x, CO, CO₂, SO₂, PM, VOCs); Minor dust emissions from localized surface disturbance. Operation of water management infrastructure (pumps, sediment removal): Combustion emissions from pumps and powered systems; Minor dust emissions during sediment removal and handling. Vehicle traffic on TSF perimeter roads and internal access routes: Combustion emissions (NO_x, CO, CO₂, SO₂, PM, VOCs); Fugitive dust from unpaved surfaces. 	<ul style="list-style-type: none"> Decommissioning and dismantling of infrastructure (plant, generators, hydro-cyclone house): Combustion emissions from equipment used in dismantling; Fugitive dust from disturbance and material handling. Earthworks for final landform regrading and stabilization (benching, shaping embankments): Fugitive particulate matter (TSP, PM₁₀, PM_{2.5}); Combustion emissions from earthmoving equipment. Rehabilitation activities (soil placement, revegetation, surface stabilization): Fugitive dust during soil handling and placement; Minor combustion emissions from mobile equipment. Transport of waste materials and salvaged equipment: Combustion emissions from vehicles; Fugitive dust from project road traffic.
Infrastructure Corridor	<ul style="list-style-type: none"> Clearing and grading along 87-km-long infrastructure corridor (~50 m wide): Fugitive particulate matter (TSP, PM₁₀, PM_{2.5}) from vegetation removal and earthworks; combustion emissions from construction equipment; minor VOC emissions from handling and storage of cleared vegetation. 	<ul style="list-style-type: none"> Transport of tailings slurry via pipeline (continuous operation): No direct air emissions; Indirect emissions from pumps and support equipment (NO_x, CO, CO₂, SO₂, PM, VOCs). 	<ul style="list-style-type: none"> Dismantling and removal (or salvage) of pump stations, valve/choke stations, and associated infrastructure: Combustion emissions (NO_x, CO, CO₂, SO₂, PM, VOCs) from dismantling equipment;

Project Component	Construction	Operation	• Closure and Rehabilitation Phase
	<ul style="list-style-type: none"> Trenching and installation of tailings pipeline (buried and aboveground sections): Fugitive dust from trenching and backfilling; Combustion emissions from construction equipment. Construction and upgrade of access roads (65 km): Fugitive dust from earthworks, grading, and unpaved surfaces; Combustion emissions from construction vehicle fleets. Bridge construction (Ok Tedi, Ok Taub, Ok Birim crossings): Fugitive dust from earthworks and material handling; Combustion emissions from cranes and heavy equipment. Construction of culverts and ravine crossings: Fugitive particulate emissions from excavation and installation; Combustion emissions from construction equipment. Temporary access roads and construction tracks: Fugitive dust from grading and traffic on unsealed surfaces; Combustion emissions from vehicles. Transport of materials, equipment, and workforce (road freight and crew buses): Combustion emissions (NO_x, CO, CO₂, SO₂, PM, VOCs); Fugitive dust from unsealed roads. 	<ul style="list-style-type: none"> Operation of pump and valve/choke stations: Combustion emissions (NO_x, CO, CO₂, SO₂, PM, VOCs) from power generation and maintenance activities. Routine inspection and maintenance of pipeline, roads, and bridges: Combustion emissions from maintenance vehicles and equipment; Minor fugitive dust from localized disturbance. Operational traffic along pipeline access road and shared road networks: Combustion emissions (NO_x, CO, CO₂, SO₂, PM, VOCs); Fugitive dust from unsealed road use by project and community vehicles. Transport of supplies, materials, and personnel during operations: Combustion emissions from trucks, light vehicles, and crew buses; Fugitive dust from traffic on unsealed roads. 	<p>fugitive dust from disturbance and material handling.</p> <ul style="list-style-type: none"> Continued use of access roads by local communities post-closure: Ongoing combustion emissions from vehicle traffic; fugitive dust from unsealed road use by community and residual project activities. Rehabilitation of disturbed areas (including pipeline corridor, work areas, and access roads where applicable): Fugitive particulate matter (TSP, PM₁₀, PM_{2.5}) from soil reworking and site stabilization; minor combustion emissions from rehabilitation equipment. Transport of salvaged materials and waste: Combustion emissions from vehicles; fugitive dust from haul road traffic.

3.1 CONSTRUCTION PHASE ACTIVITIES AND EMISSION SOURCES

Construction of the Project includes development of the Tailings Storage Facility (TSF), installation of the associated pipeline, establishment of access roads, construction camps, laydown areas, and supporting infrastructure. Construction activities represent the period with the highest short-term potential for air emissions due to the intensity of equipment use and land disturbance. While operation activities represent the period with the most consistent long term for potential emissions:

3.1.1 Mobile Construction Equipment and Project Traffic

Construction activities include the operation of diesel-powered mobile equipment, including excavators, bulldozers, graders, loaders, cranes, dump trucks, and ancillary support vehicles. These units are used for land clearing, earthworks, trenching, material placement, TSF embankment construction, pipeline installation, and site grading. In addition, construction traffic includes haul trucks, crew transport buses, fuel trucks, water carts, and supply vehicles operating on public and project roads.

During the construction phase, a substantial portion of vehicle movements will be associated with the transport of construction materials, including general fill, borrow materials, and gravel sourced from bulk earthworks and local extraction areas along the Ok Tedi and surrounding areas. These materials will be transported via a combination of river and road logistics, with bulk materials initially delivered to OTML's Kiunga port facilities and subsequently trucked via the Kiunga–Tabubil Highway to the mine area and onward to the TSF site using the highway, pipeline access road and ITCS Road network.

Haulage of borrow fill and construction materials from extraction areas along the Ok Tedi to the TSF will primarily occur using heavy-duty dump trucks operating along designated project routes, including the pipeline access road, Kiunga–Tabubil Highway and ITCS Road. These routes include both existing road infrastructure (e.g., highway) and new road infrastructure within the infrastructure corridor and TSF development area.

Construction traffic is expected to include a combination of heavy-duty haul trucks for material transport, light- and medium-duty vehicles for personnel and equipment transport, and buses used for workforce movement between accommodation facilities and work fronts. Worker transport will include regular bus movements to and from construction camps and work areas, while material haulage will occur on a frequent and continuous basis during active construction periods, particularly during peak earthworks and embankment construction activities.

Traffic volumes along the pipeline access road are anticipated to be highest during the construction phase, with design estimates indicating that the road will accommodate up to approximately 150 vehicle movements per day, including a substantial proportion of heavy-duty vehicles (approximately 50%) associated with material haulage and construction logistics. Traffic flows will vary spatially along the corridor, with the highest vehicle activity expected near active construction fronts, borrow areas, and the TSF footprint, and lower traffic volumes along less active sections of the corridor.

In contrast, vehicle movements during operations are expected to be substantially reduced and will primarily consist of routine inspection, maintenance, and limited material transport activities, resulting in a lower frequency of heavy-duty vehicle movements compared to construction.

Combustion emissions from construction equipment and vehicle fleet include nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO₂), particulate matter (PM₁₀ and PM_{2.5}), and greenhouse gases (GHGs), with emissions varying spatially and temporally as construction progresses along the TSF footprint and pipeline alignment.

3.1.2 Stationary Combustion Sources

Temporary stationary combustion sources will be used during the construction phase to supply power to work areas across the TSF development area and infrastructure corridor. These sources will primarily comprise diesel-fired generators deployed at construction camps, laydown areas, workshops, maintenance stations, and active construction fronts along the infrastructure corridor and TSF development area. Construction power supply will be provided through a combination of medium and small generator units, including approximately four to five diesel generators rated at 55 kVA located at key facilities such as maintenance stations along the pipeline and at the TSF site, as well as an additional 26 smaller diesel generators rated at 7 kVA distributed across work sites to supply power to mobile pipeline construction crews.

In addition to diesel generators, stationary combustion sources during construction will include pumps and auxiliary equipment used for dewatering, water extraction, and pipeline installation activities located along the infrastructure corridor and at the TSF site. Operation of these generators and stationary equipment will result in localized emissions of nitrogen oxides (NO_x), carbon monoxide (CO), sulphur dioxide (SO₂), particulate matter (PM), volatile organic compounds (VOCs), and greenhouse gases (GHGs). The spatial distribution and intensity of emissions will vary depending on construction sequencing, with higher emissions associated with major work areas such as the TSF footprint, hydro-cyclone house construction site, pipeline work fronts, and construction camps.

Fuel consumption associated with on-site power generation during construction contributes to overall diesel usage and associated emissions for the project.

3.1.3 Fugitive Dust from Earthworks and Material Handling

Fugitive dust emissions will be generated during a wide range of earthworks and material handling activities associated with construction of the TSF and infrastructure corridor. These activities include land clearing, grubbing, topsoil stripping, bulk earthworks, excavation, filling, grading, embankment construction, trenching and backfilling for pipelines, and construction of roads, bridges, and surface water management infrastructure.

Additional sources of fugitive dust include the extraction, handling, and transport of borrow materials and gravel from the Ok Tedi, including approximately 4 Mm³ of material expected to be excavated, dewatered, stockpiled, and hauled for use in TSF construction, access roads, and drainage infrastructure. These activities involve repeated loading, unloading, and rehandling of materials, contributing to increased particulate emissions, particularly during dry conditions.

Dust emissions will also be generated from vehicle movement on unsealed roads and construction tracks, including the 87-km-long pipeline access road to be established along the corridor. Traffic-related dust will be influenced by vehicle type, speed, and road conditions, with heavy-duty haul trucks transporting construction materials and borrow fill representing a key contributor.

Material handling activities such as stockpiling of soils, gravel, and construction materials, as well as placement and spreading of fill during TSF starter embankment construction and progressive embankment raising, will also generate fugitive particulate matter. Exposed surfaces, including cleared land and temporary stockpiles, may be subject to wind erosion, resulting in additional fugitive dust emissions.

These activities primarily generate total suspended particulates (TSP) and particulate matter with diameters less than 10 microns (PM₁₀), with finer fractions (PM_{2.5}) generated to a lesser extent. Emission rates will vary spatially and temporally depending on soil characteristics, construction intensity, material moisture content, meteorological conditions (e.g., wind speed and precipitation), and the implementation of dust suppression measures such as water application, surface stabilization, and traffic management.

3.1.4 Land Clearing, Grubbing, and Site Preparation

Land clearing and site preparation activities will be conducted across both the TSF development area (approximately 1,500 ha) and the infrastructure corridor (approximately 400 ha).

Works will involve mechanical clearing and grubbing of trees, shrubs, and ground cover, followed by stripping and stockpiling of topsoil and organic material for later reuse in rehabilitation. These activities will be accompanied by site grading, bulk earthworks, and preparation of foundations for infrastructure, including the TSF starter embankment, access roads and bridges, and pipeline.

Clearing and preparation works will expose large areas of soil and create temporary stockpiles of topsoil and excavated material, increasing the potential for wind-blown dust emissions. Additional particulate emissions will occur during handling and transport of cleared vegetation and organic material, including chipping, mulching, stockpiling, and potential off-site removal or reuse.

These activities will generate short-term emissions of particulate matter (primarily TSP and PM₁₀), as well as combustion-related emissions including carbon monoxide (CO), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and greenhouse gases (GHGs) from the operation of heavy machinery such as excavators, dozers, and haul trucks. While land clearing activities occur across a large spatial footprint at the project scale, emissions are generated progressively within active work areas. As a result, air quality impacts are expected to be predominantly localized to the immediate vicinity of active construction zones, with elevated emissions occurring during initial clearing and peak earthworks phases before shifting as construction advances.

3.2 OPERATIONAL PHASE ACTIVITIES AND EMISSION SOURCES

During operations, air emissions will be associated with ongoing TSF management, on-site power generation, transportation for project operations, , routine maintenance activities, and supporting site infrastructure. Operational emission sources will be fewer in number and generally lower in intensity than during construction but may occur over a longer duration.

3.2.1 Operational Mobile Equipment and Maintenance Activities

Operational activities will involve the use of mobile equipment for staged TSF development, tailings placement and compaction, routine maintenance and inspections, and other general activities across the TSF development area and infrastructure corridor. These activities are expected to include the use of heavy equipment (e.g., excavators, dozers, and loaders) for TSF embankment raising and hydraulic sand cell construction, as well as project transportation during operations.

Vehicle movements during operations will be significantly reduced compared to the construction phase and will primarily consist of truck delivery of materials, equipment, and supplies to the TSF and associated infrastructure as well as light- and crew bus vehicles for workforce transport, routine inspection, and maintenance activities. Continued use of the pipeline access road, ITCS Road, and existing regional road network will support operational logistics, with lower traffic volumes and limited heavy-duty vehicle movements relative to construction activities.

Combustion emissions from these mobile sources will include nitrogen oxides (NO_x), carbon monoxide (CO), sulphur dioxide (SO₂), particulate matter (PM), volatile organic compounds (VOCs), and greenhouse gases (GHGs). Localized increases of such emissions will be spatially distributed across the TSF development area and along the infrastructure corridor and project transport routes.

These activities represent an ongoing but lower-intensity source of combustion-related emissions compared to the construction phase, during which traffic volumes are expected to increase substantially over 20 years, with design estimates of up to approximately 150 vehicle movements per day, including a significant proportion of

heavy-duty vehicles associated with material haulage and construction logistics. In contrast, operational traffic is limited to routine inspection, maintenance, and periodic transport activities, resulting in comparatively reduced emission intensity.

3.2.2 Stationary Power Generation and Support Equipment

During operations, stationary combustion sources will primarily consist of diesel-fired generators used to supply power to the TSF, hydro-cyclone house, and associated ancillary infrastructure, as the project area is not connected to an established electricity grid. Power generation will be provided by approximately ten diesel generator units, each rated at approximately 1,250 kVA. These generators will be located within or adjacent to the hydro-cyclone house and are designed to provide a total installed generating capacity of up to approximately 11 megawatts to meet peak operational power demand.

Additional stationary combustion sources during operations will include pumps and powered systems associated with the TSF operations where diesel-driven equipment is used. These systems will operate continuously or intermittently to support TSF water management. Combustion emissions from stationary sources during operations will include NO_x, CO, SO₂, PM, VOCs, and GHGs, with emissions generally concentrated at the TSF site and hydro-cyclone facility, and varying over time in response to operational demand and system utilization.

Fuel consumption associated with on-site power generation during the operational phase contributes to overall diesel usage and associated emissions for the project.

3.2.3 Fugitive Dust from Operational Surfaces

Fugitive dust emissions during operations will arise primarily from vehicle movement on unpaved roads, exposed TSF embankment surfaces, and localized disturbed areas associated with routine maintenance and inspection activities. Operational traffic will utilize the pipeline access road, the TSF perimeter road, the ITCS Road, and other internal access tracks, all of which are unsealed with gravel surfaces.

Additional sources of fugitive dust include areas of active TSF embankment raising and hydraulic sand cell construction, where exposed materials are periodically reworked and reshaped using mobile equipment. These activities may result in localized dust emissions from material placement, grading, and compaction.

At the same time, progressive rehabilitation of disturbed areas following construction, including stabilization of surfaces and reduction of the operational footprint, will reduce the extent of exposed soils and limit the potential for wind-blown dust emissions. As a result, fugitive dust emissions during operations are expected to occur at lower rates compared to construction, reflecting reduced activity levels, more stable surface conditions, and decreased frequency of heavy-duty vehicle movements.

These emissions will primarily consist of total suspended particulates (TSP) and particulate matter less than 10 microns in aerodynamic diameter (PM₁₀), with emission rates influenced by traffic intensity, road conditions, material moisture content, and prevailing meteorological conditions.

3.3 DECOMMISSIONING AND CLOSURE ACTIVITIES

Decommissioning activities will include the dismantling and removal of infrastructure, decommissioning of services, site rehabilitation, regrading of disturbed areas, and revegetation to establish a stable, erosion-resistant landform consistent with closure objectives. These activities will be undertaken across the TSF development area and infrastructure corridor, while subsurface infrastructure such as the tailings pipeline will remain in place and project roads and bridges will be maintained for continued use by the local community.

Closure works will involve earthworks associated with landform reshaping, including for the TSF, surface water drainage features (e.g., channels, spillways, and stilling basins), as well as placement of cover materials

(including topsoil and growth media), and re-establishment of vegetation cover. These activities are consistent with construction earthworks in terms of emission sources, but occur at a lower spatial extent and intensity.

Emission sources during decommissioning and closure will include combustion emissions associated with operating mobile equipment (e.g., excavators, dozers, and haul trucks), vehicle traffic associated with material transport and demolition activities, and limited stationary equipment used for site works. Fugitive dust emissions will be generated from soil disturbance during regrading, handling and placement of cover materials, and movement of vehicles on unsealed roads and yet to be rehabilitated surfaces.

The intensity and spatial extent of emissions during this phase are expected to be lower than during peak construction activities due to the reduced scale of active works and progressive rehabilitation and stabilization of landforms, which will reduce exposed surfaces and limit wind erosion. These emissions will primarily consist of TSP and PM₁₀, with additional combustion-related emissions (NO_x, CO, SO₂, PM, VOCs, and GHGs) associated with equipment operation.

3.4 POLLUTANTS OF INTEREST

Based on the project activities and associated air emission sources, the pollutants of interest for the air quality assessment include:

- Total Suspended Particulates (TSP) – representative of overall dust generated primarily from earthworks and material handling.
- PM₁₀ – associated with fugitive dust.
- PM_{2.5} – associated with diesel combustion.
- Nitrogen Oxides (NO_x) (assessed primarily as NO₂) associated with diesel combustion
- Greenhouse Gases (GHG): Carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), primarily generated from fuel combustion and vegetation clearing. The inclusion of vegetation clearing contributes primarily to increases in Green House Gases and has therefore been explicitly considered in the assessment.

Other pollutants such as carbon monoxide (CO) and sulfur dioxide (SO₂) are generated in small quantities compared to particulate matter and NO_x.

4. ASSESSMENT APPROACH

The air quality assessment has been undertaken using a structured, tiered, and risk-based approach that integrates quantitative dispersion modelling and qualitative assessment methods. The approach considers the magnitude, spatial extent, duration, and frequency of emissions, as well as the nature and sensitivity of potential receptors within the receiving environment.

The assessment distinguishes between emission sources that are continuous and predictable (e.g., stationary combustion and routine operations), and those that are intermittent or variable (e.g., construction activities and fugitive dust), allowing the level of assessment detail to be proportionate to the potential for impact. This framework is consistent with international good practice, including guidance from the International Finance Corporation (IFC) Performance Standards (2012) and Institute of Air Quality Management (IAQM), and aligns with the level of detail appropriate for an ESIA.

4.1 EMISSION CHARACTERISATION

Emission sources associated with the Project have been identified and categorised based on activity type, spatial extent, and temporal variability. These include:

- Continuous combustion sources, such as diesel-powered generators and operational equipment
- Mobile combustion sources, including construction equipment and vehicle movements
- Fugitive dust sources, including earthworks, material handling, exposed surfaces, stockpiling, and plant / vehicle movements on unsealed roads and surfaces

For combustion-related sources, emissions have been quantified using a combination of project-specific activity data (e.g., equipment types, fuel consumption, and operating hours) and established emission factors from internationally recognised databases (e.g., DSEWPC NPI and equivalent guidance).

Fugitive dust emissions have been characterised using established methodologies for construction and unpaved road emissions, incorporating conservative assumptions regarding silt content, vehicle activity, and control effectiveness. Where project-specific data were limited, conservative input parameters have been adopted to ensure that potential impacts are not underestimated.

Emission rates for modelling purposes have been developed to reflect the distinct phases of the Project (construction, operations, and closure), with particular emphasis on peak construction activities and representative operational scenarios.

4.2 DISPERSION MODELLING AND QUALITATIVE ASSESSMENT

A combination of quantitative dispersion modelling and qualitative assessment has been applied to evaluate potential air quality impacts for all project sources and activities. Quantitative methods have been applied in greater detail for emission sources that are continuous, well-defined, and contribute most significantly to overall emissions, including stationary combustion sources and representative mobile equipment and vehicle activities. These sources have been assessed using dispersion modelling to predict ground-level concentrations based on project-specific emission estimates, meteorological conditions, terrain, and receptor locations.

Quantitative dispersion modelling was undertaken to evaluate potential off-site impacts from project emissions using steady-state atmospheric dispersion modelling consistent with internationally accepted regulatory practice. The modelling was implemented using the US EPA/AMS regulatory model AERMOD, with model inputs developed to reflect project source characteristics, emission rates, site-representative meteorological conditions, local terrain and receptor locations, and conservative assumptions such that predicted ground-level concentrations represent a reasonable upper bound on potential impacts.

The modelling utilised the latest approved regulatory version of AERMOD available at the time of assessment, together with associated pre- and post-processors in accordance with current regulatory guidance. Terrain effects were incorporated using AERMAP to determine receptor elevations and hill-height scaling factors based on high-resolution terrain data, and the model configuration followed regulatory default settings unless a site-specific technical justification supported alternative options.

Qualitative assessment was completed in parallel to provide an additional line of evidence on impact likelihood and significance for all source categories and project phases, and to support interpretation of the quantitative outputs in the context of source intermittency, activity sequencing, and embedded mitigation. This includes qualitative consideration of construction and operational activities that vary spatially and temporally across the TSF development area and the infrastructure corridor (e.g., earthworks, haulage, unsealed road traffic, and other diffuse activities), ensuring the assessment remains complete across both continuous and intermittent emission processes.

4.3 EVALUATION AND MANAGEMENT

Predicted air quality impacts have been evaluated against applicable ambient air quality criteria, including relevant national standards and international guidelines (e.g., IFC and World Health Organization air quality guidelines, where applicable).

The assessment considers both short-term (acute) and long-term (chronic) exposure scenarios and evaluates the significance of impacts in the context of baseline air quality conditions and receptor sensitivity.

Mitigation measures for combustion emissions and fugitive dust have been considered through a combination of design controls, construction and operational practices, and implementation of environmental management plans. Key measures include traffic management, dust suppression (e.g., water application and surface stabilisation), equipment maintenance, and progressive rehabilitation of disturbed areas.

The effectiveness of these measures is considered in both the qualitative and quantitative components of the assessment, providing a realistic and conservative evaluation of residual air quality impacts.

5. IMPACT ASSESSMENT CRITERIA

This section defines the biophysical environmental values relevant to air emissions, describes the types of air quality criteria used to evaluate potential impacts, and summarises the legislation, guidelines, and standards used to select appropriate assessment criteria for this study. Consistent with PNG practice for major projects, the assessment draws on internationally recognised guidance due to the lack of PNG statutory ambient air quality standards.

5.1 DEFINING BIOPHYSICAL ENVIRONMENTAL VALUES

For the purposes of this assessment, biophysical environmental values are defined as the environmental attributes and receptors that may be affected by air emissions from project activities and that are relevant to regulatory compliance, ecological integrity, and community amenity. These values have been identified based on the nature of project emission sources, the characteristics of the receiving environment, and the applicable international guidelines used in the assessment.

Key environmental values considered in this air quality assessment include:

- Human health, including short-term and long-term exposure to combustion-related pollutants and particulate matter;
- Local amenity, including the potential for nuisance dust, soiling, and reduction in the enjoyment of surrounding areas;
- Property and infrastructure, including the potential for dust deposition to affect the useful life, cleanliness, and appearance of buildings, structures, and materials; and
- Climatic systems, through greenhouse gas emissions (assessed separately in the greenhouse gas assessment).

These environmental values form the basis for the selection of assessment criteria and indicators used in both the quantitative and qualitative components of the assessment. Health-based criteria have been applied for pollutants such as fine particulate matter (PM_{2.5}), inhalable particulate matter (PM₁₀) and nitrogen dioxide (NO₂), while amenity and ecological considerations have been assessed using indicators such as total suspended particulates (TSP) and dust deposition, consistent with the nature of project emissions from earthworks, material handling, and unsealed road use.

5.2 TYPES OF AIR QUALITY CRITERIA

Air quality impacts associated with the Project will be assessed via: (1) ambient air quality criteria, which relate to predicted ground-level concentrations at sensitive receptors, and (2) source-based controls, which address emission performance at the point of release and the effectiveness of operational management measures.

For this Project, ambient air quality criteria are applied to the pollutants and averaging periods assessed in the quantitative and qualitative components of the study, with a focus on particulate matter (TSP, PM₁₀, PM_{2.5}) and combustion pollutants (NO_x assessed primarily as NO₂, CO, SO₂). These criteria are used to evaluate modeled or otherwise assessed downwind concentrations at villages and other receptors potentially affected by emissions from construction activities, unsealed road traffic, and stationary combustion sources, and are interpreted in the context of cumulative exposure (i.e., project contribution plus background where applicable).

Source-based controls are relevant to the Project's principal stationary combustion sources and to the embedded management measures applied to fugitive sources. During construction, stationary sources include diesel generators supporting worksites, including four to five 55 kVA diesel generators used at maintenance stations and the TSF site and 26 smaller 7 kVA generators deployed across work fronts to supply power to mobile pipeline crews. During operations, stationary combustion becomes a major and continuous emissions driver at the TSF site, where power demand is supplied by approximately ten 1,250 kVA (3.3 kV) diesel generators (with additional standby units) housed in or near the hydro-cyclone house, providing up to ~11 MW installed capacity. In addition, the Project includes pumps and powered systems associated with tailings delivery and TSF water management (e.g., decant recovery systems and supporting infrastructure), which contribute combustion emissions where diesel-driven equipment is used.

Consistent with projects of this type, the majority of potential air emission sources during construction are fugitive and mobile, rather than point sources. Key fugitive sources include land clearing and bulk earthworks across the TSF development area (~1,500 ha) and the infrastructure corridor (~400 ha), material handling and stockpiling, and traffic on unsealed roads / tracks and exposed surfaces. Construction traffic is expected to be highest along the pipeline access road and TSF access routes. These fugitive sources are managed through operational controls (e.g., dust suppression, traffic management, progressive rehabilitation) and are evaluated primarily through particulate indicators (TSP, PM₁₀, PM_{2.5}) and dust deposition/soiling endpoints, while the point-source stationary generators are evaluated through modeled or assessed ground-level impacts for combustion pollutants in addition to particulate matter.

5.3 OVERVIEW OF RELEVANT LEGISLATION AND GUIDELINES

5.3.1 PNG Environmental Legislation

The Conservation and Environment Protection Authority (CEPA) is the PNG government agency responsible for administering the Environment Act 2000, which regulates the environmental impacts of development and requires the identification, assessment, and management of potential adverse effects associated with project activities.

In the context of air quality, CEPA has issued guidance relevant to atmospheric emissions through the Guideline for Submission of an Application for an Environmental Permit to Discharge Waste (GLEnv/03/2004) and the associated Air Discharges Additional Information Guideline (IB-ENV/02/2004). These documents define the technical information requirements for assessing air emissions as part of an environmental permit application, rather than prescribing specific numerical standards.

The CEPA guidance has been applied in this assessment to define the scope and level of detail of the air quality impact assessment, including:

- Characterisation of emission sources (type, location, magnitude, and temporal variation);
- Identification and quantification of emissions from both combustion and fugitive sources;
- Evaluation of ground-level pollutant concentrations using appropriate predictive methods; and
- Assessment of potential impacts on human health, local communities, and the surrounding environment.

Consistent with the CEPA guidance, this assessment includes detailed consideration of:

- Stationary combustion sources, including diesel-powered generators used during construction and the centralised on-site power generation system with ~11 MW capacity during operations;
- Mobile and transport-related emissions, including heavy-duty vehicle movements (up to ~150 vehicle movements per day during construction);
- Fugitive dust sources, including earthworks, material handling, unsealed road traffic, and borrow extraction activities along the Ok Tedi; and
- Project activities including TSF construction and operations, and the infrastructure corridor development area and progressive rehabilitation.

Importantly, PNG does not prescribe statutory ambient air quality standards or emission limits under the current guidance. As a result, the assessment adopts internationally recognised air quality criteria to provide a defensible and quantitative evaluation of potential impacts, consistent with CEPA expectations for major resource development projects.

5.3.2 IFC Assessment Requirements

The IFC Environmental, Health and Safety (EHS) Guidelines – Air Emissions and Ambient Air Quality have been adopted as the primary basis for defining air quality assessment criteria and evaluation methods for the Project. These guidelines provide internationally recognised performance standards for assessing and managing air emissions, particularly in jurisdictions where national standards are limited or absent.

For the purposes of this Project, guidance on emissions reduction and control strategies for power generation is drawn specifically from the IFC General EHS Guidelines (Air Emissions and Ambient Air Quality), which provide recommended measures for power generation activities from sources with a capacity equal to or lower than 50 MW, as well as for mobile sources. This is directly applicable to the Project because operational power demand will be supplied by on-site diesel generation with a total installed capacity of up to approximately 11 MW.

Accordingly, the IFC guidance is used in this report to frame practicable emissions minimisation and control expectations for the Project's diesel power generation system and for mobile sources (construction and operational fleets), alongside evaluation of predicted ambient impacts against the adopted ambient criteria

Consistent with IFC requirements, this assessment:

- Applies quantitative dispersion modelling using AERMOD to key emission sources such as the stationary combustion and representative mobile activities and the fugitive emissions sources to predict ground-level concentrations of pollutants;
- Applies qualitative assessment methods (including IAQM-based approaches) to evaluate fugitive and variable emission sources such as construction dust, vegetation clearing, and unsealed road traffic; and
- Incorporates project-specific activity data, meteorology, terrain, and receptor locations to assess potential impacts at nearby communities and sensitive receptors.

Ambient air quality criteria used in this assessment are aligned with IFC guidance, which requires the application of national standards where available, or internationally recognised guidelines such as the World Health Organization (WHO) Air Quality Guidelines. These criteria have been applied to assess project-related concentrations of key pollutants, including:

- PM_{2.5} and PM₁₀ (health-based particulate exposure);
- NO₂, CO, and SO₂ (combustion-related pollutants); and
- TSP and dust deposition indicators (used to assess nuisance dust and amenity impacts).

The IFC guidelines also recommend that project-related emissions should not result in exceedance of applicable ambient standards and should avoid contributing disproportionately to pollutant concentrations within the airshed. In this assessment, predicted project contributions have been evaluated in the context of these requirements, with consideration given to the relative contribution of project emissions during construction (dominated by fugitive dust and mobile sources) and operations (increasing contribution from stationary combustion sources at the TSF site).

The IFC EHS Guidelines for Mining further inform the assessment by identifying the principal emission sources relevant to mining and tailings storage projects, including:

- Fugitive dust from exposed surfaces, tailings facilities, haul roads, and material handling; and
- Combustion emissions from stationary generators and mobile construction and operational equipment.

These source categories directly align with the emission sources identified and assessed for the Project, and the mitigation measures described in subsequent sections reflect IFC-recommended practices, including dust suppression, traffic management, progressive rehabilitation, and equipment management.

5.3.3 World Health Organization

The World Health Organization (WHO) provides globally recognized, health-based air quality guideline values intended to protect public health from the adverse effects of ambient air pollution. These guidelines are developed based on comprehensive, systematic reviews of scientific literature, with a focus on epidemiological evidence linking air pollution exposure to a wide range of health outcomes.

In 2021, the WHO released a major update to its Global Air Quality Guidelines, replacing the previous 2005 guidelines. The 2021 update reflects substantial advances in scientific understanding over the last 15 years and incorporates evidence demonstrating that adverse health effects occur at air pollutant concentrations lower than previously recognized, with no clearly identifiable safe thresholds for several key pollutants.

Key updates in the 2021 WHO guidelines include:

- Substantially lower guideline levels for major criteria pollutants, particularly fine particulate matter (PM_{2.5}), coarse particulate matter (PM₁₀), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂), reflecting stronger and more consistent associations between exposure and cardiopulmonary morbidity and mortality.
- New long-term (annual) guideline values for NO₂ and updated short-term guideline values for SO₂ and ozone (O₃), strengthening the framework for assessing both chronic and acute exposure risks.
- Introduction of interim targets designed to support a stepwise approach for countries and regions working toward alignment with the guideline values where immediate attainment may not be feasible.

The WHO 2021 Air Quality Guidelines emphasize protection against a broad range of health endpoints, including premature mortality, cardiovascular disease, respiratory illness, adverse birth outcomes, and impacts on vulnerable populations such as children, the elderly, and individuals with pre-existing health conditions.

Although the WHO guidelines are not legally enforceable standards, they are widely used internationally as health-protection benchmarks for environmental impact assessment. Regulatory agencies, researchers, and practitioners frequently reference WHO guideline values to contextualize modeled or monitored pollutant concentrations and to evaluate the potential public health significance of air emissions.

The WHO has indicated that the 2021 guidelines represent the lowest exposure levels currently supported by robust scientific evidence, and that further reductions in air pollutant concentrations below these levels are expected to yield additional public health benefits.

5.3.4 United States Environmental Protection Agency

The United States Environmental Protection Agency (US EPA) establishes National Ambient Air Quality Standards (NAAQS) under the Clean Air Act (40 CFR Part 50) for six principal (“criteria”) air pollutants: particulate matter (PM_{2.5} and PM₁₀), ozone (O₃), carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), and lead (Pb). These standards define allowable concentrations of pollutants in ambient air to which the general public may be exposed and are widely referenced internationally due to the robust scientific and regulatory review processes underpinning their development.

The Clean Air Act defines two categories of NAAQS:

- Primary standards, which are health-based and designed to protect public health, including sensitive populations such as children, the elderly, and individuals with respiratory or cardiovascular conditions; and
- Secondary standards, which are designed to protect public welfare. Public welfare explicitly includes protection against effects on visibility, soils and water, crops, vegetation, and ecosystems, wildlife, and man-made materials (e.g., soiling or deterioration of buildings), as well as broader impacts to property, economic values, and community amenity and comfort.

In many cases, secondary standards are set at the same level as primary standards where the same concentration is considered protective of both health and welfare; however, for some pollutants (e.g., SO₂), secondary standards are defined separately to address welfare-specific endpoints such as ecological effects.

For the purposes of this assessment, the adopted air quality criteria are based primarily on the WHO Air Quality Guidelines (2021) for health-based pollutants, supplemented by EPA NAAQS standards and legacy TSP benchmarks for the assessment of nuisance and amenity-related dust impacts, as described in Section 4.3.6.

It is also noted that total suspended particulates (TSP) is no longer a regulated EPA criteria pollutant; however, TSP and related metrics remain relevant for evaluating nuisance dust and amenity impacts in construction and mining environments.

Table 4 US EPA National Ambient Air Quality Standards (NAAQS), Reference Values (µg/m³)

Note: Several NAAQS are defined in ppm or ppb; values below are presented in µg/m³ using standard atmospheric conversion for consistency with assessment outputs.

Pollutant	Averaging Time	Primary Standard (µg/m ³)	Secondary Standard (µg/m ³)
PM _{2.5}	Annual	9.0	15.0
PM _{2.5}	24-hour	35	35
PM ₁₀	24-hour	150	150
O ₃	8-hour	137	137
CO	8-hour	10,300	–
CO	1-hour	40,000	–
NO ₂	Annual	100	100

Pollutant	Averaging Time	Primary Standard ($\mu\text{g}/\text{m}^3$)	Secondary Standard ($\mu\text{g}/\text{m}^3$)
NO ₂	1-hour	188	–
SO ₂	1-hour	196	–
SO ₂	Annual	–	26
Pb	3-month average	0.15	0.15

5.3.5 Australian Regulatory Requirements

Dust deposition criteria are not uniformly standardised internationally; however, established regulatory practice in Australia—particularly guidance from the New South Wales Environment Protection Authority (NSW EPA)—provides widely recognised benchmarks for assessing nuisance and amenity impacts associated with fugitive dust emissions. These criteria are based on long-standing application in mining, infrastructure, and construction projects, and are commonly adopted in environmental impact assessments where formal national standards are absent.

Dust deposition is typically measured as the rate of insoluble particulate matter deposited on surfaces over a defined period (e.g., grams per square metre per month, $\text{g}/\text{m}^2/\text{month}$), representing the potential for visible dust accumulation, soiling, and associated amenity impacts at sensitive receptors.

NSW EPA guidance and established assessment practice define the following benchmark criteria:

- 2 $\text{g}/\text{m}^2/\text{month}$ (incremental) — maximum allowable increase in dust deposition attributable to the Project above background levels; and
- 4 $\text{g}/\text{m}^2/\text{month}$ (total) — maximum allowable total dust deposition rate (including background), typically assessed as a rolling annual average.

These criteria are not health-based but are intended to protect local amenity and environmental welfare, including:

- Prevention of visible dust accumulation on buildings, infrastructure, and vegetation;
- Protection of surface cleanliness and property condition;
- Limitation of nuisance impacts such as dustiness and reduced enjoyment of outdoor areas; and
- Minimisation of secondary effects on vegetation and soil surfaces.

Given the nature of the project, fugitive dust represents a dominant emission pathway. As such, dust deposition criteria provide an important complement to airborne particulate concentration criteria (PM₁₀ and PM_{2.5}) by capturing non-health-based impact pathways that are not adequately represented through ambient concentration metrics alone.

These NSW EPA benchmarks have been widely applied in PNG environmental impact assessments and mining projects, and their use in this assessment provides a defensible and internationally recognised basis for evaluating potential nuisance dust impacts in the absence of PNG-specific deposition standards.

These criteria are also consistent with IAQM guidance for assessing dust effects on amenity receptors

5.3.6 Ambient Air Quality Criteria Adopted for this Assessment.

The adopted criteria are used as impact assessment benchmarks and are not proposed as prescriptive compliance limits, unless otherwise required by approval conditions.

Table 5 Ambient Air Quality Criteria Adopted for this Assessment

Pollutant	Averaging Period	Criterion	Source / Basis	Notes
NO₂	Annual	100 µg/m ³	US EPA NAAQS	Health-based
NO₂	1 hour	188 µg/m ³	US EPA NAAQS	98th Percentile
TSP	24-hour	150 µg/m ³	US EPA legacy criteria (pre-1987)	Nuisance / amenity context only
TSP	Annual	75 µg/m ³	US EPA legacy criteria (pre-1987)	Nuisance / amenity context only
PM₁₀	Annual	15 µg/m ³	WHO Air Quality Guidelines (2021)	Health-based
PM₁₀	24-hour	45 µg/m ³	WHO Air Quality Guidelines (2021)	99th percentile
PM_{2.5}	Annual	5 µg/m ³	WHO Air Quality Guidelines (2021)	Health-based
PM_{2.5}	24-hour	15 µg/m ³	WHO Air Quality Guidelines (2021)	99th percentile
Dust Deposition	Month	2 g/m ² /month	NSW EPA	Incremental
Dust Deposition	Month	4 g/m ² /month	NSW EPA	Total

6. EXISTING ENVIRONMENT

This section describes the existing physical and environmental setting relevant to development of the Ok Birim Tailings Storage Facility (TSF) and associated infrastructure corridor. The description is based on information compiled in the Ok Birim TSF Pre-Feasibility Study (PFS) Design Basis, the TSF PFS Design Update, and the TSF Capital and Sustaining Cost Estimate studies prepared for Ok Tedi Mining Limited (OTML), as well as the baseline characterization for the Environmental and Social Impact Assessment.

6.1 TSF AREA

6.1.1 Local Topography and Land Use

The proposed Ok Birim TSF is located on the western side of the Ok Tedi River in the Western Province of Papua New Guinea, on the southern slopes of the Central Cordillera within the North Fly region. The TSF development area is situated within a lowland fluvial and alluvial environment, characterised by gently undulating terrain associated with river floodplains, terraces, and depositional landforms formed by the Ok Tedi and Ok Birim river systems.

Topography across the TSF footprint is defined by a broad valley setting with relatively low relief compared to the adjacent highlands surrounding the Ok Tedi Mine. Local variations in elevation and landform are influenced by historical and ongoing geomorphological processes, including floodplain inundation, channel migration, sediment deposition, and overbank processes, which have resulted in a complex mosaic of land facets.

This geomorphic setting provides suitable conditions for development of a ring-dyke TSF configuration, enabling staged embankment construction within a relatively laterally extensive and topographically subdued environment, while minimising the need for significant cut-and-fill earthworks.

Land use within the TSF development area is predominantly undeveloped and characterised by dense tropical vegetation, including riverine forest, floodplain vegetation, and lowland rainforest communities. There are no settlements within the proposed footprint; however, it is used intermittently by local communities for subsistence activities, including hunting, fishing, and gathering.

No notable infrastructure is present within the TSF footprint, although regional infrastructure such as the Tabubil–Kiunga corridor and river transport routes are located within the broader project area.

6.1.2 Climate and Meteorology

6.1.2.1 Regional and Project Climate Setting

The TSF development area is located within a tropical monsoonal climate regime, characterised by consistently warm temperatures, high humidity, and significant rainfall throughout the year. Papua New Guinea experiences strong climatic variability driven by the interaction of the Southeast Trade Winds, the Northwest Monsoon, and the Inter-Tropical Convergence Zone (ITCZ), as well as broader climatic drivers such as the El Niño–Southern Oscillation (ENSO).

Within the Köppen–Geiger classification, the project area lies within the Af climatic zone (equatorial, fully humid climate), with:

- Mean monthly temperatures consistently exceeding 18°C, and
- Rainfall occurring throughout the year with no distinct dry season.

6.1.2.2 Rainfall and Hydrometeorology

The rainfall within the project area is extremely high by global standards, reflecting strong orographic influences associated with the Central Cordillera and persistent convective rainfall processes.

Regional annual rainfall ranges from approximately 4,000 mm to more than 10,000 mm. Recorded average rainfall is approximately:

- ~7,400 mm/year at Karandimok Village (nearest station, ~1.6 km from the TSF);
- ~6,650 mm/year at PMP59;

- ~5,500 mm/year at Bige; and
- up to ~9,800 mm/year at higher-elevation stations near the Ok Tedi Mine.

Rainfall occurs year-round, with seasonal variation driven by atmospheric circulation:

- May to October: dominated by Southeast Trade Winds, producing sustained and often intense rainfall on windward slopes;
- December to March: Northwest Monsoon influences, with alternating heavy rainfall and intermittent drier periods;
- Transitional conditions occur in April and November.

Rainfall events are frequently intense and localised, driven by convective processes, and can generate high short-duration rainfall intensities that influence sediment transport, flood behaviour, and TSF water management requirements.

6.1.2.3 Temperature, Humidity, and Evaporation

Temperatures are relatively uniform year-round, with:

- Average annual temperature approximately 27–28°C,
- Typical monthly range of approximately 24.8°C to 31.1°C

Humidity is consistently high, typically ranging between ~87% and 92%, reflecting the tropical and fully humid climate conditions.

Evaporation rates are relatively low compared to rainfall, with:

- Annual pan evaporation of approximately ~770 mm, and
- Estimated evapotranspiration of approximately ~535 mm/year,

These evaporation rates indicate a strong net positive moisture balance, which contributes to persistent wet ground conditions and generally suppresses dust generation.

6.1.2.4 Wind Speed and Direction

Wind conditions in the TSF area are generally low to moderate, with average wind speeds typically in the range of ~1.5 to 1.8 m/s, based on data from the Bige weather station.

Wind direction varies seasonally in accordance with regional circulation patterns:

- January to March:
 - Generally calm morning conditions
 - Light winds from the northwest, strengthening to westerly winds in the afternoon (monsoonal influence)
- July to September:
 - Predominantly southeasterly winds, associated with the Southeast Trade Winds

These seasonal wind patterns influence the transport and dispersion of airborne particulates, particularly during drier periods.

6.1.3 Local Communities

Settlements in the vicinity of the TSF development area include a number of villages and communities located along the Ok Tedi and Ok Birim river systems and within the surrounding lowland areas (Table 6).

Key communities located in proximity to the TSF include Kungembit, Karandimok, Birimkamba, and Ambaga, situated at distances of approximately 900 m to 1,800 m from the TSF footprint. Additional communities are distributed within approximately 1 km to 10 km of the TSF. Smaller settlements, as well as community facilities such as schools and local infrastructure, are also present within the broader area.

Table 6. Local Communities Surrounding the TSF

Local Communities Surrounding the TSF	
Tarubitis	Birmkamba
Bingkwuk	Alice Pit
Kungim	Ningerum
Kungembit	Awin Tamaro
Putmambin	Hiorinkia
Patung Soekarno PLB	Hosokumgu
Yetekun	Pampenai
Ambaga	Wangenai
Komokpin	Mendua
Karandimok	Mimingiri

6.1.4 Existing Air Quality

Ambient air quality in the vicinity of the TSF development area is generally good and characteristic of rural tropical environments, with limited sustained anthropogenic emission sources. The baseline air environment reflects the remote nature of the area, combined with high rainfall, high humidity, and low to moderate wind speeds, which act to suppress dust generation and reduce the persistence of airborne particulates.

There is no site-specific ambient air quality monitoring currently available within the Project footprint. However, regional monitoring undertaken by Ok Tedi Mining Limited (OTML) provides a relevant indication of baseline conditions in comparable environments within the broader project area.

A dust monitoring study conducted by OTML in 2022 at locations along the Tabubil–Kiunga corridor and at Bige stockpiles indicates that:

- Particulate matter concentrations ($PM_{2.5}$ and PM_{10}) are generally low and within WHO Air Quality Guideline values;
- Occasional short-term exceedances of $PM_{2.5}$ can occur under dry conditions and in proximity to active sources (e.g., traffic or material handling); and
- Dust levels are frequently suppressed by persistent rainfall, resulting in relatively low overall ambient concentrations.

These findings are considered representative of baseline conditions at the TSF development area, where similar climatic conditions and limited emission sources are present.

6.1.4.1 Local Emission Sources

Existing emission sources in the TSF area are limited and intermittent, and include:

- Fugitive dust from unsealed surfaces, including local tracks and exposed soils, particularly during short dry periods;
- Small-scale land disturbance associated with subsistence activities, such as vegetation clearing and soil exposure;
- Combustion emissions from occasional vehicle movements, river transport, and community activities (e.g., cooking fires and open burning); and
- Regional contributions from existing OTML operations, including the Ok Tedi Mine (~55 km north) and Bige operations (~20–25 km south), although these are expected to contribute only minor background influences at the TSF site due to distance and prevailing meteorological conditions.

6.1.4.2 Sensitive Receptors and Exposure

Although no formally designated protected areas have been identified within the TSF development area, the surrounding region supports lowland tropical rainforest ecosystems, as well as subsistence land-use areas and riverine environments. These environmental and community receptors may be sensitive to changes in air quality, including dust deposition and particulate emissions.

The spatial distribution of nearby communities, as described in Section 5.1.3, indicates that potential exposure is greatest for receptors located in close proximity to the TSF, particularly within approximately 5 km of the footprint and along prevailing wind directions. Based on this understanding, the air quality assessment has focused on representative locations that capture the nearest and most potentially exposed community receptors (sensitive receptors) for the TSF development area.

Sensitive receptors identified for the purposes of the air quality assessment include nearby villages and community-use areas located at distances of approximately 900 m to 1,800 m from the TSF footprint. These locations represent the primary points at which potential exposure to project-related emissions may occur. Sensitive receptors used in the air quality assessment are presented in Figure 5-1

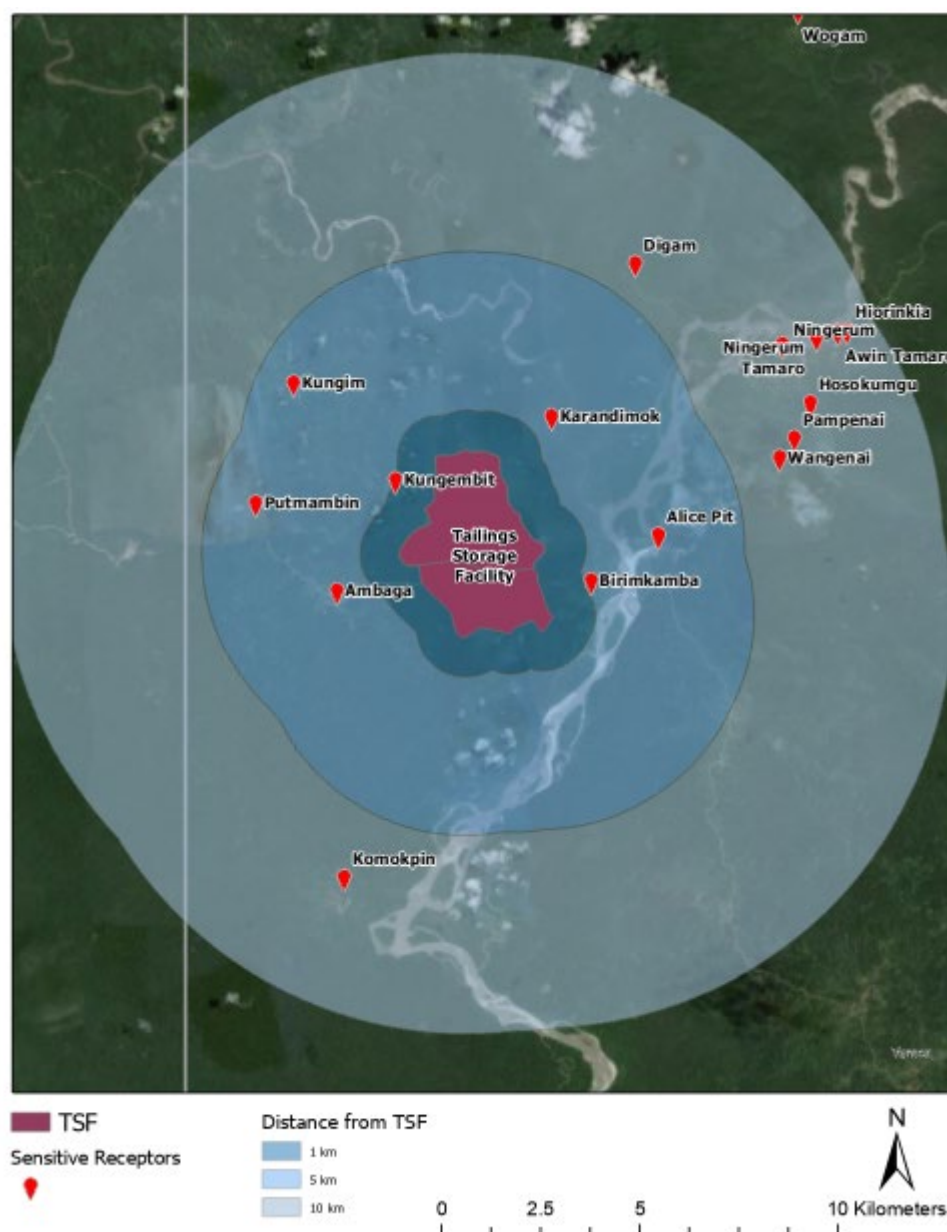


Figure 5-1 Sensitive Receptors for the TSF.

Given the intermittent nature of emission sources and the strong influence of frequent rainfall, elevated particulate concentrations in the existing environment are expected to be short-term, localized, and highly dependent on weather conditions and activity levels

6.1.4.3 Baseline Characterisation

Overall, ambient air quality in the TSF development area can be characterised as, low in pollutant concentrations under typical conditions, dominated by natural and low-intensity anthropogenic sources; and subject to occasional short-term increases in particulate matter during dry periods or in proximity to localized activities.

6.2 INFRASTRUCTURE CORRIDOR

6.2.1 Local Topography and Land Use

The infrastructure corridor comprises the tailings delivery pipeline and associated access road extending from the Ok Tedi Mine to the Ok Birim TSF site. The corridor traverses a range of terrain associated with the transition from the upland mine environment to the lowland TSF area, including:

- steep upland slopes and foothills in the vicinity of the Ok Tedi Mine;
- moderately sloping terrain and incised drainage features along the mid-corridor; and
- gently undulating lowland terrain approaching the TSF development area.

Elevation decreases significantly along the alignment, from approximately 1,700 m above sea level at the mine to less than 100 m within the TSF area, reflecting the regional topographic gradient from the Central Cordillera toward the Ok Tedi River system.

Land use along the corridor is characterised by:

- dense tropical rainforest and secondary vegetation;
- localized disturbed areas associated with existing access tracks and mine-related infrastructure; and
- scattered communities and subsistence land use areas.

Settlement patterns are linear and river-oriented, reflecting reliance on river transport and access routes. These areas represent key sensitive receptors, particularly where the infrastructure corridor passes in close proximity to village land or community use areas.

6.2.2 Climate and Meteorology

Climatic and meteorological conditions along the infrastructure corridor are consistent with those described for the TSF development area and reflect the broader climate of the Ok Tedi catchment.

The corridor is subject to a tropical monsoonal climate, characterised by:

- high annual rainfall,
- frequent high-intensity rainfall events, and
- persistently warm and humid conditions throughout the year.

While rainfall is consistently high across the corridor, local climatic variability is influenced by elevation, with:

- higher rainfall and more variable conditions in upland areas near the mine; and
- slightly lower, but still fully humid conditions in the lowlands near the TSF.

Wind conditions along the corridor are generally low to moderate, consistent with regional monitoring data, and, combined with frequent rainfall, tend to limit sustained wind-driven dust transport, although temporary localized dust generation may occur during dry periods and active construction.

6.2.3 Local Communities

Communities within the infrastructure corridor development area are distributed along the length of the alignment and are summarized in Table 7. These communities consist primarily of scattered villages and community-use areas located along the Ok Tedi River, its tributaries, and adjacent access routes, reflecting the strongly linear settlement pattern of the region.

In addition to riverside communities, settlements are also located along the Kiunga–Tabubil Highway and other established transport corridors, where residential areas, local infrastructure, and subsistence land-use activities occur in proximity to the proposed works.

The spatial distribution of these communities, in combination with the linear nature of the infrastructure corridor, results in multiple locations where communities are situated in close proximity to segments of the corridor alignment, including access roads, crossings, and ancillary infrastructure. These communities form the primary human-use areas within the corridor and surrounding environment.

Table 7. Communities Located Within the Infrastructure Corridor Development Area

Local Communities Along the Infrastructure Corridor Development Area	
Finalbin	Niokskiwi/Ok Ma
Bultem	Walawam
Kavorabip	Kolebon
Kawentikin	Wogam
Tabubil	Ningerum
Kumguit	Awin Tamaro
Wangbin	Hiorinkia
Kumkit/Ankit	Karandimok
Ok Teditau	Alice Pit
	Birmkamba

6.2.4 Existing Air Quality

Ambient air quality along the infrastructure corridor development area is generally consistent with that described for the TSF development area, characterised by low background pollutant concentrations typical of rural and semi-remote tropical environments. High rainfall and humidity, combined with relatively low wind speeds, act to limit dust generation and reduce the persistence of airborne particulates.

Local emission sources along the corridor are limited and intermittent, and include:

- Fugitive dust from vehicle movements on unsealed roads and tracks, particularly during drier periods;
- Small-scale land disturbance associated with subsistence activities; and
- Combustion-related emissions from vehicles, river transport, and domestic activities (e.g., cooking fires and open burning).

Consistent with the TSF development area, baseline particulate concentrations are expected to be low overall, with any elevated levels typically short-lived and spatially limited due to frequent rainfall and the absence of significant continuous emission sources.

6.2.5 Sensitive Receptors

Sensitive receptors associated with the infrastructure corridor are primarily defined by communities located in close proximity to the corridor alignment, particularly those situated within approximately 1 km to 3 km of the

development area. These receptors are derived from the local communities described in Section 5.2.3 and represent locations where human-use areas and community infrastructure occur near the proposed works.

For the purposes of the air quality assessment, sensitive receptors have been selected to represent the nearest and most relevant community locations along the corridor, including villages situated adjacent to access routes, crossings, and other infrastructure components. These locations form the basis for subsequent quantitative modelling and qualitative impact assessment.

Figure 5-2 presents the spatial distribution of sensitive receptors for the infrastructure corridor development area..

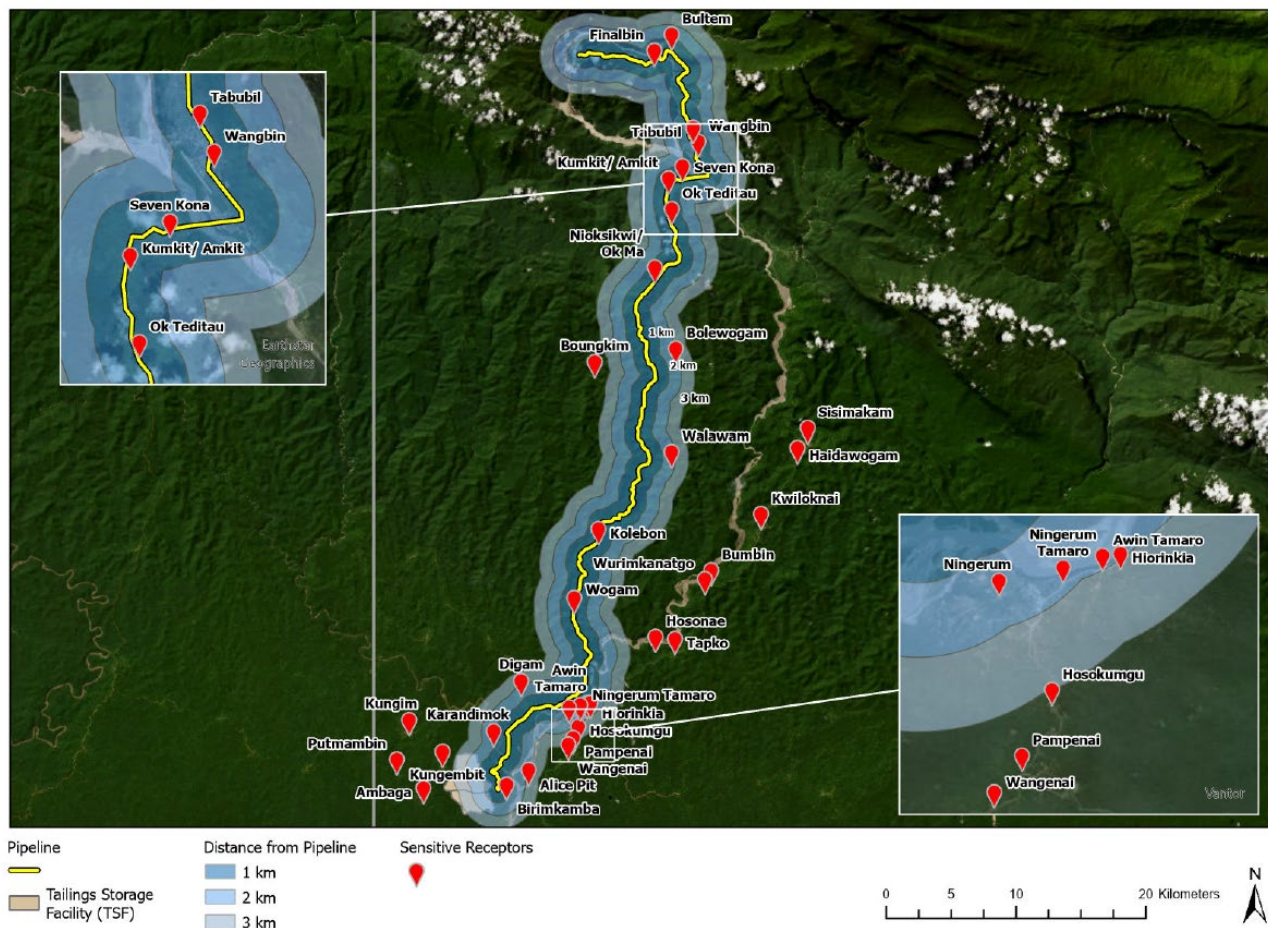


Figure 5-2 Sensitive Receptors for the Infrastructure Corridor Area.

7. IMPACT ASSESSMENT METHODS

7.1 QUANTITATIVE IMPACT ASSESSMENT

A quantitative air quality impact assessment was undertaken to evaluate potential off-site impacts from project-related emissions, with particular focus on sensitive receptors located in the vicinity of the TSF development area and along the infrastructure corridor.

The assessment employed steady-state atmospheric dispersion modelling in accordance with internationally accepted regulatory practice and current air quality science. Predicted ground-level concentrations were compared with the adopted ambient air quality criteria (Section 4.3.6) to evaluate potential impacts.

The dispersion modelling accounted for:

- source characteristics and emission rates;
- local terrain conditions;
- site-representative meteorological inputs; and
- the spatial distribution of receptors, including near-field communities identified within approximately 5 km of the TSF and along the corridor alignment.

Conservative assumptions were applied to provide a reasonable upper-bound estimate of potential impacts under representative operating conditions.

7.1.1 Dispersion Models Used (AERMOD)

Atmospheric dispersion modelling was conducted using AERMOD, a steady-state Gaussian plume model developed by the American Meteorological Society and the United States Environmental Protection Agency (US EPA). AERMOD is specifically designed to predict the dispersion of air pollutants from stationary sources over distances of up to approximately 50 km and is widely accepted by regulatory agencies for industrial air quality assessments.

The assessment utilised the latest approved regulatory version of AERMOD available at the time of modelling, together with all associated pre- and post-processing executables in accordance with current US EPA guidance. These included:

- AERMAP – terrain pre-processor used to calculate receptor elevations and hill-height scaling factors based on high-resolution terrain data; and
- Model configuration followed regulatory default settings unless site-specific justification existed to apply alternative options.

Conservative assumptions were adopted so predicted concentrations represent a reasonable upper bound on potential impacts.

7.1.2 Meteorological Data Used in Dispersion Modelling

Meteorological inputs play a critical role in determining pollutant dispersion and transport. For air quality assessments using dispersion modelling, meteorological datasets must be both temporally appropriate and representative of site conditions. Dispersion modelling requires hourly meteorological data to appropriately characterise atmospheric dynamics and to enable assessment of short-term (acute) impacts, such as those associated with nitrogen dioxide (NO₂).

Several meteorological datasets were considered for this assessment:

Bigge Weather Station:

The Bigge station is the nearest available monitoring location to the proposed TSF site and is considered representative of regional climatic conditions at the TSF development area. However, the available dataset is recorded at a daily temporal resolution, which is not suitable for dispersion modelling applications that require hourly inputs. As such, this dataset could not be used directly for modelling purposes.

Tabubil Weather Station:

The Tabubil station provides hourly-resolution data, satisfying temporal requirements; however, it is located near the Ok Tedi Mine in a mountainous upland environment on the slopes of the Central Cordillera. Meteorological conditions at this location are strongly influenced by complex terrain effects, including terrain-induced channelling and slope-driven flows, which are not representative of the lower-elevation TSF

development area or parts of the infrastructure corridor. Therefore, use of this dataset would not provide an appropriate characterisation of dispersion conditions at the Project site.

Selected Meteorological Dataset (Adopted for Modelling): Port Moresby

The meteorological dataset adopted for this assessment is derived from a coastal/port-based station located at a greater distance from the Project area, but which provides continuous hourly data suitable for dispersion modelling. Although not located within or near the project area, this dataset demonstrates similar regional-scale meteorological behaviour to the Bige station, particularly in terms of prevailing wind directions and overall wind regime, and has been previously applied and accepted by regulatory authorities in Papua New Guinea for comparable large-scale project assessments.

The Bige dataset represents local site conditions but is limited to daily temporal resolution, whereas the adopted dataset provides hourly data suitable for modelling. Both datasets exhibit a dominant southeasterly wind direction and similar wind speed distributions, indicating that the adopted dataset provides a reasonable representation of regional wind patterns relevant to the Project

Minor differences between datasets are expected due to local influences; however, the adopted dataset appropriately reflects regional-scale atmospheric behaviour, while also satisfying the temporal resolution requirements necessary for dispersion modelling.

Accordingly, the selected meteorological dataset provides a practical and defensible basis for the assessment, representing a balance between data quality, temporal resolution, and regional representativeness, and ensuring that predicted concentrations are suitable for evaluating potential air quality impacts.

7.1.3 Accuracy of Modelling

Atmospheric dispersion modelling is an established tool for assessing potential air quality impacts; however, it necessarily involves simplification of complex atmospheric processes. Predicted concentrations should therefore be interpreted as reasonable estimates of potential impacts, rather than exact values at any given location or time.

Key considerations affecting model accuracy for this assessment include:

- Meteorological variability, particularly under low to moderate wind speed conditions, which are common in the Project area and can be challenging for Gaussian dispersion models to represent accurately;
- Use of a surrogate meteorological dataset, which, although demonstrated to be representative of regional wind patterns as explained in the previous section, introduces some uncertainty relative to site-specific conditions;
- Emission rate uncertainty, as emissions inventories represent best estimates based on available data and reasonable operating assumptions;
- Source characterisation assumptions, including continuous operation and conservative treatment of emission release parameters; and
- Terrain, which are incorporated using high-resolution data and accepted algorithms but still involve inherent simplifications of real-world processes.

To address these factors, conservative modelling assumptions were applied throughout the assessment. These include:

- Use of continuous or worst-case operating scenarios, whereby emission sources are assumed to operate at maximum or sustained levels, rather than reflecting intermittent or variable real-world activity (e.g., construction equipment usage or traffic movements);

- Exclusion of rainfall suppression effects on fugitive dust emissions, despite the Project area experiencing high rainfall and humidity, which in practice would significantly reduce dust generation and persistence;
- Use of representative meteorological conditions without accounting for site-specific dispersion-enhancing effects, such as localised topographic variability or surface roughness that may increase turbulence and dilution;
- Application of regulatory default model options, which are generally conservative and tend to produce higher predicted concentrations; and
- Receptor-focused evaluation at sensitive locations, including communities near the emission sources, ensuring that predicted impacts reflect potential exposure at the most affected locations.

Accordingly, predicted ground-level concentrations are expected to err on the side of over-prediction, providing a protective and conservative basis for assessing potential impacts at sensitive receptors.

When applied in this manner, AERMOD provides a reliable indication of the magnitude and spatial distribution of potential air quality impacts, and the results are therefore suitable for comparison against adopted criteria and for informing impact significance evaluations

7.2 QUALITATIVE IMPACT ASSESSMENT

7.2.1 Construction Dust Risk Assessment Method

Construction-phase activities associated with development of the TSF and infrastructure corridor have the potential to generate temporary fugitive dust emissions, which may affect nearby human and ecological receptors. Potential impacts include nuisance effects (e.g., dust deposition and soiling), short-term human health effects associated with elevated particulate matter concentrations (PM₁₀), and potential effects on vegetation and other sensitive ecological receptors.

A qualitative construction dust impact assessment has been undertaken in accordance with the Institute of Air IAQM Guidance on the Assessment of Dust from Demolition and Construction (2024, Version 2.2). The IAQM methodology provides a structured, risk-based framework for evaluating the potential for dust emissions from construction activities and for identifying appropriate, proportionate mitigation measures.

The IAQM qualitative methodology comprises the following key steps:

- Step 1. Screening the need for a detailed assessment
- Step 2. Assessment of the risk of dust impacts
- Step 3. Identification of appropriate mitigation measures
- Step 4. Determination of residual impacts

This assessment considers the potential for unmitigated dust emissions during construction prior to the application of standard mitigation measures, consistent with IAQM guidance.

The IAQM guidance adopts a risk-based approach in which the potential for dust impacts is determined by combining the magnitude of dust-generating activities with the sensitivity of surrounding receptors. This process does not prescribe fixed significance thresholds; rather, it provides a structured framework to inform professional judgement regarding the likely scale of impacts.

For the purposes of this assessment, the resulting impact categories (Low, Medium, High, and Large) have been interpreted qualitatively, as summarised in Table 8 to support a consistent and transparent description of potential effects.

Table 8 Interpretation of IAQM Dust Impact Categories

Impact Category	Typical IAQM Basis	Description of Effect	Spatial Extent	Implication for Assessment
Low	Small emission magnitude and/or low receptor sensitivity	Minimal dust generation with limited potential for noticeable soiling or changes in ambient particulate concentrations	Highly localised to the immediate source area; effects not perceptible at most receptors	Impacts are negligible to minor and unlikely to influence air quality criteria or community amenity
Medium	Moderate emission magnitude and/or moderate receptor sensitivity	Noticeable dust generation during active works, including potential short-term increases in particulate concentrations and localised soiling	Localised near active work areas and unsealed routes; may be intermittently observable at nearby receptors	Impacts are generally short-term and managed through standard mitigation; unlikely to result in exceedances of air quality criteria
High	Large emission magnitude and/or high receptor sensitivity	Significant dust generation potential with increased likelihood of visible dust, nuisance, and elevated particulate concentrations during peak activities	Extends beyond the immediate works area, particularly where activities occur near receptors or along transport corridors	Impacts may be noticeable at sensitive receptors and require enhanced mitigation and management measures
Large (or “Very High” / “Substantial” depending on terminology used)	Large emission magnitude combined with high receptor sensitivity	Substantial dust generation potential with a high likelihood of persistent or repeated effects, including nuisance dust deposition and elevated particulate concentrations	Broad spatial extent or sustained exposure near sensitive receptors, particularly under unfavourable meteorological conditions	Represents a key impact pathway requiring detailed assessment, modelling, and robust mitigation to ensure acceptable outcomes

Receptor Context and Key Sensitivity Considerations

The Project area covers locations where sensitive human receptors are present in close proximity to proposed construction activities. Receptors include villages, individual dwellings, and community-use areas, some of which are located adjacent to or within short distances of the proposed construction footprint, particularly along sections of the infrastructure corridor.

Construction activities associated with the Project—including earthworks, material handling, vehicle movements on unsealed surfaces, and pipeline installation—will occur within these areas and, in some locations, in direct proximity to receptors, resulting in the potential for short-range exposure to fugitive dust emissions.

In accordance with IAQM guidance, separation distance between emission sources and receptors is a key determinant of dust risk. Larger particles, which contribute to dust deposition and soiling, typically settle within approximately 100 to 500 m of the source, while finer particles may travel further depending on meteorological conditions. Where receptors are located within this near-field zone, particularly those immediately adjacent to construction activities, the potential for both nuisance and short-term health impacts is materially increased.

Given the close spatial relationship between construction activities and sensitive receptors in certain areas of the Project area, particularly along the infrastructure corridor, dust risk has been assessed conservatively, with emphasis on receptor locations where direct and continuous exposure may occur during active works.

7.2.1.2 Step 1: Screening Assessment

Consistent with IAQM guidance, an initial screening was undertaken to determine whether sensitive receptors are located within distances where construction dust impacts could reasonably occur.

The IAQM guidance indicates that a detailed dust assessment is required where:

- Human receptors are located within:
 - 250 m of the construction site boundary; or
 - 50 m of construction traffic routes on public roads (up to 250 m from site access points).
- Ecological receptors are located within:
 - 50 m of the site boundary or construction traffic routes.

Based on the project layout and surrounding land uses, human receptors are present within the relevant screening distances. Accordingly, a qualitative dust risk assessment was undertaken in line with IAQM guidance.

7.2.1.3 Step 2: Assessment of Risk of Dust Impacts

The risk of potential dust impacts is determined by combining:

- Dust emission magnitude, based on the scale and nature of construction activities; and
- Sensitivity of the surrounding area, based on receptor type and proximity.

Step 2A: Dust Emission Magnitude

Dust emission magnitude was assessed separately for each construction activity type identified by IAQM:

- Earthworks
- Construction activities
- Movement of construction vehicles on local roads (mostly unsealed)

Step 2B: Sensitivity of the Area

The sensitivity of surrounding receptors was assessed with reference to IAQM criteria for:

- Dust deposition effects on people and property; and
- Human health effects associated with PM₁₀.

Nearby receptors include residential and occupational receptors that are considered moderately sensitive to dust soiling and health impacts, given their proximity to the site and duration of potential exposure.

Step 2C: Risk Evaluation

For each construction activity type, the dust emission magnitude (Step 2A) and area sensitivity (Step 2B) are combined using the IAQM risk matrices to determine the unmitigated risk of dust effects.

The risk evaluation categorizes the likelihood and potential consequence of dust effects as Negligible, Low, Medium, or High, separately considering:

- dust soiling (amenity effects); and
- human health effects associated with particulate matter (PM₁₀)

These risk categories represent the inherent risk prior to the implementation of mitigation measures, and are used to inform the type and level of mitigation required in accordance with IAQM guidance.

The IAQM risk classification does not represent the final assessment of environmental impact, but rather provides a structured basis for identifying appropriate control measures. Residual impacts are subsequently determined following the application of mitigation measures (Step 4).

In accordance with IAQM guidance, risk is distinct from significance and should not be interpreted as a direct indicator of impact without consideration of mitigation

7.2.1.4 Step 3: Mitigation Measures

In accordance with IAQM guidance, the level of mitigation required is determined by the unmitigated dust risk category identified in Step 2C

Activities classified as Medium or High risk require progressively more robust, site-specific, and actively managed mitigation measures to control fugitive dust emissions and reduce potential exposure at nearby receptors.

For this Project, mitigation measures have been defined with specific consideration of:

- The proximity of sensitive receptors to construction activities (including villages and community-use areas located adjacent to the infrastructure corridor and within the TSF area); and
- The nature and scale of construction activities, including pipeline installation, earthworks, material handling, and vehicle movements on unsealed surfaces.

Typical mitigation measures include, but are not limited to:

- Targeted dust suppression as needed, such as water spraying or damping of work areas, haul routes, and exposed surfaces, applied selectively during periods of reduced rainfall or where ground conditions become sufficiently dry to generate dust emissions. Given the generally high rainfall and humid conditions at the Project site, active dust suppression is expected to be intermittent and focused on short-duration dry conditions, rather than continuously required;
- Management of construction traffic, including speed control, approved transport routes, and minimization of unnecessary vehicle movements in proximity to receptors;
- Stabilization and management of exposed materials, including timely treatment, covering, or compaction of stockpiles and disturbed areas;
- Control of material tracking, including measures to limit the transfer of fine materials and mud from active construction areas onto access tracks and local road network. This includes management of vehicle movements to prevent the build-up and redistribution of loose or wet material, particularly under wet conditions where soil adherence to tires and equipment may occur, and under dry conditions where deposited material may subsequently dry and generate dust through vehicle disturbance, and

- Operational controls during construction, including limiting or modifying activities that generate elevated dust emissions during periods of dry weather or unfavorable dispersion conditions (e.g., low wind speeds or wind directions toward nearby receptors).

Mitigation measures will be implemented in a proportionate manner, with higher-risk activities requiring more frequent monitoring, active management, and, where necessary, site-specific control measures.

Overall, the purpose of these measures is to reduce dust emissions at source and limit off-site transport, thereby minimizing the potential for nuisance and short-term health effects at nearby receptors during the construction phase.

7.2.1.5 Step 4: Residual Impact Assessment

Following the identification and application of appropriate mitigation measures, the residual impacts of construction dust emissions are assessed.

Residual impacts represent the level of effect expected after mitigation has been implemented, taking into account:

- the effectiveness of proposed control measures;
- the continued proximity of sensitive receptors to construction activities; and
- the temporary and short-term nature of construction-phase emissions.

In accordance with IAQM guidance, the purpose of this step is to determine whether potential dust effects remain at a level that could give rise to significant impacts once good practice mitigation measures are in place.

Where mitigation is effectively implemented and actively managed, residual impacts are typically reduced to Low or, in some cases, Medium levels, reflecting the reduced likelihood and magnitude of dust effects at nearby receptors.

Residual construction dust impacts are expected to be:

- temporary and short-term, occurring only during active construction;
- localized to areas in proximity to works; and
- reversible, with conditions returning to baseline following completion of activities.

8. AIR QUALITY IMPACT ASSESSMENT

8.1 ASSESSMENT SCENARIOS

Three assessment scenarios were considered to evaluate potential air quality impacts associated with the Project's criteria pollutant inventory:

- Construction of the infrastructure corridor development area;
- Construction of the TSF development area; and
- Operation of the TSF development area

Each scenario represents a distinct set of activities, emission sources, and exposure pathways, and has been assessed using an approach appropriate to the nature, duration, and spatial extent of emissions.

The assessment approach differentiates between:

- Construction-phase activities, which are typically temporary, spatially variable, and dominated by fugitive dust emissions, and

- Operational-phase activities, which are generally more continuous and associated with defined emission sources, and are therefore more suited to quantitative dispersion modelling.

This structured scenario-based approach ensures that both short-term, localized construction effects and longer-term operational emissions are appropriately characterised and evaluated in relation to identified sensitive receptors

8.1.1 Emission Sources

Emission sources for the Project were identified and quantified using a combination of project-specific design information, activity data, and emissions estimation methodologies. Inputs include available OTML design data, fuel consumption estimates, equipment inventories, and anticipated construction and operational activities.

Emissions have been estimated using emission factor-based approaches, primarily derived from the Australian Government's National Pollutant Inventory (NPI) Emission Estimation Technique (EET) Manuals, which provide established methodologies for calculating emissions associated with combustion processes and fugitive dust generation. These methods are consistent with accepted practice for environmental impact assessment where direct measurement data are not available.

The assessment considers two primary categories of emissions relevant to the Project:

- Combustion-related emissions, associated with the operation of diesel-powered equipment and other fuel-consuming sources, including construction machinery, haulage vehicles, generators, and operational support equipment. These sources are responsible for emissions of criteria pollutants such as nitrogen oxides (NO_x), particulate matter (PM), carbon monoxide (CO), and sulfur dioxide (SO₂).
- Fugitive dust emissions, comprising mechanically generated particulate matter arising from construction and operational activities, including:
 - earthworks and surface disturbance;
 - excavation and trenching associated with the infrastructure corridor area;
 - material handling and stockpiling; and
 - vehicle movements on unsealed surfaces.

These emission source categories capture the dominant pathways for air pollutant generation during both construction and operation of the TSF and infrastructure corridor development areas

The resulting emissions inventory provides the basis for:

- quantitative dispersion modelling of construction and operational emissions; and
- qualitative assessment of construction-phase dust emissions, in accordance with the IAQM methodology.

Where project-specific data were not available, conservative assumptions consistent with NPI guidance have been applied.

8.1.2 Activity Data and Assumptions

Emissions were estimated using emission factor-based methods. Fugitive dust sources and mechanical handling activities were mapped to source categories and default emission factors in the National Pollutant Inventory (NPI) Emission Estimation Technique Manual (EETM) for Mining (Version 3.1, 2012), while combustion emissions from mobile and stationary diesel sources were calculated using the NPI EETM for Combustion Engines (Version 3.0, 2008).

For dust-generating sources, activity units were selected to match the emission factor units (e.g., vehicle-hours, tonnes handled, vehicle-kilometres travelled (VKT), and hectare-hours (ha-hrs)). For

combustion sources, activity data are expressed as litres of diesel consumed, consistent with the NPI combustion emission factor units (kg pollutant per litre).

Detailed project inputs and emission calculations are presented in Appendix A with detailed activity data for each scenario. Ket project inputs are provided in Tables 9 to 12.

Table 9 Key Project Inputs Used to Derive Activity Data

Input category	Value used in emissions inventory
Total project disturbance footprint	1,900 ha
TSF development area	1,500 ha (TSF footprint ~1,410 ha)
Infrastructure corridor development area	400 ha (includes 330 ha pipeline/access footprint and 70 ha laydown/working areas)
Pipeline length	87 km tailings delivery pipeline
Pipeline installation approach	80% buried and 20% aboveground
Pipeline access road	87 km (22 km existing highway and 65 km new road), generally unsealed; speed limits 40 km/hr internal, 65 km/hr shared
Major crossings	Three permanent bridges and several minor water/ravine crossings
Construction convoy movements (materials / supplies / equipment) via Kiunga-Tabubil Highway	2 project convoys round-trip movements/day, comprising up to 8 semi-trailer trucks/convoy (total of 16 trucks) from Kiunga to Tabubil (approximately 140 km one-way)
Construction workforce transport to TSF site via ITCS Road	3 bus round-trip movements/day, involving 12 km one-way trip from Ningerum to the TSF site
Construction workforce transport for infrastructure corridor (early phase)	6 bus round-trip movements/day from Tabubil camp plus 6 bus round-trip movements/day from Alice Pit camp over the first 1.5 years of construction; workers will be accommodated in temporary camps along the corridor route thereafter
Borrow fill / gravel haulage via ITCS Road (construction)	For transportation of approximately 4 Mm ³ local borrow fill (sourced within 5 km of TSF) during construction period, assumed 207/day one-way 45 t haul truck movements
On-site diesel power (operations). Diesel fuel consumption	Up to 11 MW installed capacity; 10 × 1,250 kVA gensets (2 standby). 11,418 kL/year (incl. conservative 11,200 kL/yr basis)
Diesel fuel consumption (construction – infrastructure corridor works)	5,023 kL/year (pipeline/access road construction)

Input category	Value used in emissions inventory
Diesel fuel consumption (construction – TSF works)	3,349 kL/year (TSF construction)
Diesel fuel consumption (construction – on-site power generation)	437 kL/year (construction power generation allowance)
Diesel fuel consumption (operations – transport vehicles)	1,165 kL/year
Diesel fuel consumption (construction – transport vehicles)	2,475 kL/year
Diesel fuel consumption (operations – mobile plant)	3,931 kL/year

Scenario-specific key activity data and assumptions are further presented in subsequent sections as follows: Detailed assumptions, calculation methodology, and supporting calculations are provided in Appendix A.

1. Infrastructure corridor construction (pipeline, access road, supporting vehicles and generators) — Table 10;
2. TSF construction (earthworks, internal traffic, TSF support plant) — Table 11; and
3. Project operations (mobile plant, internal traffic, and the on-site diesel power plant) — Table 12.

8.1.2.1 Infrastructure Corridor Construction

Construction work schedule: activity estimates are based on OTML traffic assumptions and fuel use rates supplied for the construction period (e.g., daily fuel usage per equipment type, convoy and bus movements).

Unsealed road dust: measured as VKT on the pipeline access road and worksite tracks, consistent with the OTML traffic assumptions and supporting calculations and vehicle movement assumptions.

Combustion activity: diesel consumption (in litres) taken directly from OTML fuel estimates for each equipment category.

Table 10 Infrastructure Corridor Construction Activity Data (Pipeline and Access Road)

Source Category	Equipment / Activity Type	Number of Units	Activity Level	Units
Fugitive Dust	Bulldozing	4	4,368	vehicle-hrs
	Excavating	6	403,844	Tonnes
	Miscellaneous transfer points	6	47,944	Tonnes
	Truck unloading (dumping)	10	403,844	Tonnes
	Unpaved roads at construction sites	21	87	VKT
	Unpaved roads used by light duty vehicles	1	63,336	VKT

Source Category	Equipment / Activity Type	Number of Units	Activity Level	Units
	Wind erosion	N/A	2,890,800	ha-hrs
	Site personnel travel unpaved roads	3	21,840	VKT
Combustion	Crew bus (22-seater)	3	218,400	Liters
	Supt vehicle	4	291,200	Liters
	Excavator	6	1,747,200	Liters
	Dump truck	10	2,184,000	Liters
	Dozer (D8)	4	582,400	Liters
	Service trucks	1	218,400	Liters
	Fuel truck	1	218,400	Liters
	Pipe loaders	3	218,400	Liters
	Cranes	3	218,400	Liters
	Pipe floater	1	72,800	Liters
	Genset 1250 kVA 415V	3	218,400	Liters
	Convoy trucks (long haul semi-trailers)	6	291,200	Liters

8.1.2.2 TSF Construction

Disturbance area: Construction activities occur within the TSF development area with internal tracks and work areas included as part of the disturbance estimate.

Unsealed road dust and internal traffic: VKT inputs represent movement of plant and vehicles on internal TSF roads/tracks and construction areas.

Wind erosion: area-based emission inputs (expressed as ha-hrs) using the TSF development area disturbance footprint and annual exposure (8,760 hrs/yr) as a conservative assumption consistent with the NPI mining wind erosion factor units.

Combustion activity: diesel consumption (in litres) taken directly from OTML fuel estimates for TSF construction plant and vehicles.

Table 11 TSF Development Area Activity Data

Source Category	Equipment / Activity Type	Number of Units	Activity Level	Units
Fugitive Dust	Bulldozing	4	4,368	vehicle-hrs
	Excavating	3	69,500,000	Tonnes

Source Category	Equipment / Activity Type	Number of Units	Activity Level	Units
	Graders	2	1,113	VKT
	Miscellaneous transfers	6	69,500,000	Tonnes
	Unpaved roads	13	189,028	VKT
	Unpaved roads used by light duty vehicles	1	1,113	VKT
	Wind Erosion	N/A	13,140,000	ha-hrs
	Site Personnel Travel Unpaved	3	13,104	VKT
Combustion	Crew Bus (22-seater)	3	218,400	Liters
	Supt Vehicle	4	291,200	Liters
	Excavator	3	873,600	Liters
	Trucks (45 tonne Moxies)	6	1,310,400	Liters
	Dozer (D8)	3	436,800	Liters
	Service Trucks	1	218,400	Liters
	Fuel Truck	1	218,400	Liters
	Grader	2	145,600	Liters
	Mobile Crushing Plant	2	145,600	Liters
	Wheel Loader	3	218,400	Liters
	IT Loader	3	218,400	Liters
	Genset (50kVA)	3	218,400	Liters
	Convoy Trucks (long haul semi-trailers)	6	291,200	Liters

8.1.2.3 Project Operations

Operational power generation: operations include on-site diesel generation up to 11 MW installed capacity, represented as 10 × 1,250 kVA units (2 standby).

Operational mobile plant and vehicles: diesel fuel use (in litres) for mobile plant and vehicles is taken directly from OTML operational fuel estimates

Unsealed road dust: VKT reflects internal TSF traffic and access movements during operations, including routine inspection/maintenance travel assumptions in the OTML traffic assumptions and supporting calculations.

Wind erosion: area-based assumptions (expressed as ha-hrs) use the overall disturbance footprint basis and annual exposure as a conservative screening approach consistent with the NPI method.

Table 12 Project Operational Activity Data

Source Category	Equipment / Activity Type	Number of Units	Activity Level	Units
Fugitive Dust	Bulldozing	4	8,760.00	vehicle-hrs
	Excavating	4	187,000.00	tonnes
	Miscellaneous transfers	6	187,000.00	tonnes
	Truck Unloading (dumping)	10	18,000,000.00	tonnes
	Unpaved roads at industrial sites	9	10,824.10	VKT
	Wind Erosion	N/A	15,505,200.00	Ha-hrs
	Site Personnel Travel Unpaved	3	13,104.00	VKT
Combustion	Excavator (45 t)	4	1,164,800	Liters
	Dozer (D8)	4	582,400	Liters
	Diesel Generator (Genset 50kVA)	3	218,400	Liters
	Gensets (11 MW installed capacity)	10 (2 on standby)	11,200,000	Liters
	Crew bus (25-57 seater)	3	218,400	Liters
	Dump Truck (20 t)	10	2,184,000	Liters
	Supt Vehicle	9	655,200	Liters
	Convoys Trucks (long haul semi-trailers)	6	291,200	Liters

8.2 ESTIMATION OF PARTICULATE EMISSIONS FROM DUST

Fugitive dust emissions were estimated for the Project area to characterise particulate matter generated by mechanical disturbance and handling of soils and materials, and by vehicle movement on unsealed surfaces, during both construction and operational phases. Dust-generating sources were defined based on the Project area activity inventory (Section 7.1.2) and mapped to relevant source categories in the National Pollutant Inventory (NPI) Emission Estimation Technique Manual (EETM) for Mining (Version 3.1, 2012). Emission factors were then assigned consistent with the NPI Mining EETM Table 2 default emission factors, including factors for bulldozing, excavation, dumping/unloading, unpaved road travel, and wind erosion.

Tables 13 to 15, list the final emissions for each respective source for both the construction and operations phases. As the NPI EETM Mining Version 3.1 2012 does not list any emission factors for PM_{2.5}, it was assumed that emission factors for PM_{2.5} are equivalent to 10% of PM₁₀ emission factors.

8.2.1 Emission Factor Basis and Particle Size Fractions

Dust emission factors were taken directly from the NPI Mining EETM default factors (Table 2) for each dust-generating source category.

The NPI Mining EETM provides default emission factors for TSP and PM₁₀, but does not provide explicit default factors for PM_{2.5} in the Table 2 source categories used for this assessment. Consistent with the assumptions applied across the emissions inventory, PM_{2.5} emissions from fugitive dust sources were estimated using a PM_{2.5}/PM₁₀ fraction of 10%, such that:

$$EF(PM_{2.5}) = 0.10 \times EF(PM_{10})$$

This approach is consistent with the particulate fraction assumptions documented in the inventory assumptions

8.2.2 Rainfall Adjustment (“Precipitation Control” Factor)

The Project area experiences high rainfall and high humidity, which substantially reduces the frequency and duration of conditions conducive to dust generation (e.g., dry exposed surfaces) and, also promotes rapid damping of disturbed surfaces following rainfall events. In recognition of this, the raw (uncontrolled) fugitive dust emissions calculated using the NPI emission factors were adjusted to reflect precipitation-related suppression of dust emissions.

A precipitation-related reduction factor was developed by comparing typical dust control effectiveness during wetter months versus relatively drier months, then averaging these seasonal conditions to represent overall annual conditions. This seasonal comparison produced an estimated average control effectiveness of approximately 80% (i.e., emissions reduced by 80% when considering wet vs. relatively drier seasonal conditions).

To maintain conservatism and account for day-to-day variability (e.g., short dry periods, localized drying of surfaces between rainfall events, and construction activities occurring during intermittent dry conditions), a lower control effectiveness of 75% was applied in the emissions inventory.

Accordingly, for all fugitive dust sources:

$$E_{\text{adjusted}} = E_{\text{raw}} \times (1 - 0.75) = 0.25 \times E_{\text{raw}}$$

This approach is consistent with the documented inventory assumption that a rainfall-related control factor is applied to particulate emissions to reflect local wet climatic conditions while retaining a conservative bias for assessment purposes.

8.2.3 Dust Deposition Calculations

Dust deposition rates were estimated using a screening-level approach based on modeled 24-hour ground-level particulate concentrations. This approach applies a standard deposition relationship in which deposition flux is calculated as the product of airborne concentration and a representative deposition velocity, reflecting the gravitational settling behavior of coarse particulate matter (TSP fraction) typically generated during construction and operational activities. This method provides an indicative estimate of dust deposition in the absence of explicit deposition modelling and is widely used in environmental impact assessments to support evaluation of nuisance dust impacts.

A representative deposition velocity consistent with coarse particulates was applied to convert modeled concentrations to monthly deposition rates.

8.2.4 Construction Phase

Fugitive dust emissions during construction were estimated for:

- Infrastructure corridor construction (pipeline and associated access infrastructure); and
- TSF construction activities, including earthworks, material handling, and unsealed road traffic within the TSF development area.

Details regarding the calculations of emissions from the construction phase are shown in appendix A, including calculation methodology, assumptions, emission factors and emission rates.

Table 13 Infrastructure Corridor Construction, Criteria Pollutant Associated to Dust Emissions

Dust Generation Sources	TSP (kg/yr)	PM10 (kg/yr)	PM2.5 (kg/yr)
Bulldozing	74,256	17,909	1,791
Excavating	2,524.02	1,211.53	121.15
Miscellaneous transfer points	3.84	1.80	0.18
Truck Unloading (dumping)	1,211.53	434.13	43.41
Unpaved roads at industrial sites	1,932	571	57.09
Unpaved roads used by light duty vehicles	14,884	5,225	522
Wind Erosion	289,080	144,540	14,454
Site Personnel Travel Unpaved Roads first half and second half	69,287	20,475	2,047
Total	453,179	190,367	19,037

Table 14 TSF Development Dust Emissions

Dust Generation Sources	TSP (kg/yr)	PM10 (kg/yr)	PM2.5 (kg/yr)
Bulldozing	74,256	17,909	1,791
Excavating	434,375	208,500	20,850
Graders	106	47.29	4.73
Miscellaneous transfers	5,560	2,606	260.63
Unpaved roads at industrial sites	199,897	59,071	5,907
Unpaved roads used by light duty vehicles	261.51	91.81	9.18

Dust Generation Sources	TSP (kg/yr)	PM10 (kg/yr)	PM2.5 (kg/yr)
Wind Erosion	1,314,000	657,000	65,700
Site Personnel Travel Unpaved	13,858	4,095	409.5
Total	2,042,313	949,320	94,932

8.2.5 Operational Phase

Operational-phase fugitive dust emissions were estimated for ongoing activities at the TSF and associated infrastructure, including:

- disturbance from periodic earthworks and material handling associated with TSF maintenance and staged development activities;
- vehicle movement on unsealed internal roads and access routes; and
- wind erosion of exposed surfaces within the operational disturbance footprint.

Table 15 Operational Criteria Pollutants Dust Generation

Dust Generation Sources	TSP (kg/yr)	PM10 (kg/yr)	PM2.5 (kg/yr)
Bulldozing	148,920	35,916	3,592
Excavating	1,168.75	561.00	56.10
Miscellaneous transfers	14.96	7.01	0.70
Truck Unloading (dumping)	54,000	19,350	1,935
Unpaved roads at industrial sites	11,446	3,382	338
Wind Erosion	1,550,520	775,260	77,526
Site Personnel Travel Unpaved	13,857.48	4,095	409.5
Total	1,779,928	838,572	83,857

Across all phases, the emissions inventory indicates that wind erosion of disturbed and exposed surfaces is a dominant contributor to annual fugitive dust emissions because the emission estimate scales with exposed area and duration of exposure (ha-hrs), consistent with the emission factor method. Vehicle movement on unsealed surfaces (VKT-based sources) and material handling activities also contribute to particulate emissions, particularly during periods of active works.

8.2.6 Summary of Fugitive Dust Emissions

Fugitive dust emissions were estimated for both the construction and operational phases of the Project based on the emission factor methodology described above. The resulting emissions represent annualised particulate loads (kg/yr) for each phase and activity grouping.

These annual emission estimates serve two primary purposes:

- to provide a quantitative indication of the relative magnitude and distribution of emission sources across the Project; and
- to form the basis for subsequent dispersion modelling, where emissions are converted to time-resolved emission rates (e.g., g/s) to evaluate ground-level concentrations at sensitive receptors.

While annual emission loads are useful for comparing overall emission intensity between project phases and for informing longer-term exposure considerations, it is noted that potential air quality impacts are ultimately governed by short-term emission rates, meteorological conditions, and proximity to receptors. Accordingly, the annual emission estimates presented here are used as inputs to the dispersion modelling assessment where they are converted to time-resolved emission rates (e.g., g/s) for evaluation of ground-level concentrations at sensitive receptors.

Overall, the results indicate that the construction phase is associated with the highest annual fugitive dust emissions, reflecting the intensity of earthworks, material handling, and widespread disturbance of exposed surfaces within a relatively short construction period (approximately 3 years).

In contrast, the operational phase extends over a longer duration (approximately 20 years) but is characterised by lower-intensity, more localised activities, resulting in a lower annual emission rate despite continued contributions from wind erosion and unsealed road traffic.

Across both phases, the dominant contributor to annual emissions is wind erosion from exposed surfaces, consistent with the large disturbance footprint of the TSF and infrastructure corridor. Secondary contributions arise from:

- vehicle movement on unsealed roads (VKT-based emissions); and
- material handling activities (e.g., excavation, unloading, and transfers).

As previously discussed and shown on the sensitive receptor figures, these sources are most relevant in areas where construction activities and unsealed traffic routes occur in close proximity to identified communities within the TSF development area and along sections of the infrastructure corridor where settlements are located adjacent to the route.

Although the inventory indicates substantial total particulate emissions, it is important to recognise that:

- emissions are distributed over large areas;
- emissions are intermittent and activity-driven (particularly during construction); and
- emissions are subject to substantial natural suppression due to high rainfall conditions, as incorporated in the rainfall adjustment factor.

Accordingly, the annual emission totals presented in this section should be interpreted as an upper-level indicator of emission magnitude, with the potential for impacts evaluated through dispersion modelling and the application of mitigation measures.

Table 16 Annual Dust Generation Emissions

Project Phase	TSP (kg/yr)	PM10 (kg/yr)	PM2.5 (kg/yr)
Annual Construction	2,495,492	1,139,688	113,969
Annual Operations	1,779,928	838,572	83,857

Table 17 Total Dust Generation Emissions

Project Phase	TSP (kg)	PM10 (kg)	PM2.5 (kg)
Total Construction	7,486,475	3,419,064	341,906
Total Operations	35,598,554	16,771,431	1,677,143
Total	43,085,029	20,190,495	2,019,049

8.3 ESTIMATION OF EMISSIONS FROM COMBUSTION SOURCES

Combustion-related emissions were estimated for the Project to characterise criteria pollutants generated by diesel-powered mobile equipment, vehicle fleets, and stationary diesel generators during construction and operations. Combustion sources were identified from the Project equipment and fuel-use inventory, which is based on OTML-provided fuel estimates and traffic assumptions, supported by the project description and equipment lists.

Emission factors were selected from the National Pollutant Inventory (NPI) Emission Estimation Technique Manual (EETM) for Combustion Engines (Version 3.0, 2008), using the appropriate source categories for on-road vehicles, off-road mobile equipment, and stationary diesel engines. Activity data were expressed as annual fuel consumption (litres) to align with the emission factor units (kg pollutant per litre), consistent with the emissions inventory approach described previously.

8.3.1 Pollutants Assessed and Treatment of Particulate Fractions

Combustion emissions were calculated for NO_x and particulate matter metrics (PM₁₀ and PM_{2.5}) consistent with the NPI combustion emission factors and the Project's assessment focus on criteria pollutants. In cases where the NPI combustion tables do not explicitly provide a TSP factor for a given source category, TSP emissions were conservatively assumed to be equivalent to PM₁₀ for inventory reporting consistency. This assumption is applied only for inventory reporting and does not change the modelling approach, which uses the relevant particulate fractions as required.

8.3.2 Use of Annual Emissions and Link to Dispersion Modelling

Tables 18 to 22 present annualised combustion emissions (kg/yr) by source for each assessment scenario. Annual totals are useful for:

- comparing overall combustion emission intensity between construction and operations; and
- identifying the dominant contributors to NO_x and PM emissions across project phases.

However, potential air quality impacts are ultimately governed by short-term emission rates, meteorology, and receptor proximity, which are evaluated in the quantitative dispersion modelling assessment, where relevant sources are represented as time-resolved emission rates and assessed at sensitive receptors.

8.3.3 Construction Phase

Combustion emissions during construction arise primarily from:

- diesel mobile equipment supporting TSF earthworks and construction activities;
- on-site and corridor-support vehicles; and
- logistics and supply transport (e.g., convoy trucks and buses).

Table 18 Criteria Pollutants Emissions from Combustion Sources Related to Infrastructure Corridor Construction

Combustion Sources	TSP (kg/yr)	PM10 (kg/yr)	PM2.5 (kg/yr)	NOx (kg/yr)	SO2 (kg/yr)	CO (kg/yr)
Transport Buses (22-seater)	460.8	460.8	452.09	6,640	3.65	1,990
Supt Vehicle	1,153.15	1,153.15	1,066.67	14,414.40	7.67	5,919
Excavator	5,350.63	5,350.63	4,923.96	60,540.48	41.86	16,605
Dump Truck	4,018.56	4,018.56	3,778.32	50,887.20	36.47	14,873
Dozer (D8)	1,783.54	1,783.54	1,641.32	20,180.16	13.95	5,535
Service Trucks	521.98	521.98	511.06	1,941.58	3.65	4,237
Fuel Truck	401.86	401.86	377.83	5,088.72	3.65	1,487
Pipe Loaders	778.38	778.38	716.40	8,504.50	5.40	2,616
Cranes	778.38	778.38	716.40	8,504.50	5.40	2,616
Pipe Floater	119.39	119.39	116.48	2,271.36	0.60	0.03
Gensets (kva)	1,113.84	1,113.84	1,087.63	15,834.00	3.65	3,407
Convoy Trucks	535.81	535.81	503.78	6,784.96	4.86	1,983
Total	17,016.3	17,016.3	15,891.9	201,591.2	130.8	61,269

Table 19 Criteria Pollutants Emissions from Combustion Processes Related to Construction

Combustion Sources	TSP (kg/yr)	PM10 (kg/yr)	PM2.5 (kg/yr)	NOx (kg/yr)	SO2 (kg/yr)	CO (kg/yr)
Transport Buses (22-seater)	460.82	460.82	452.09	6,639.36	3.65	1,990
Supt Vehicle	1,162.76	1,162.76	1,066.67	14,414.40	7.67	5,919
Excavator	2,675.31	2,675.31	2,461.98	30,270.24	20.93	8,303
Trucks (45 tonne Moxies)	2,910.27	2,910.27	2,676.75	47,135.09	33.43	20,324
Dozer (D8)	1,340.54	1,340.54	1,225.22	15,135.12	10.46	4,151
Service Trucks	521.98	521.98	511.06	1,941.58	3.65	4,237
Fuel Truck	401.86	401.86	377.83	5,088.72	36.47	1,487
Grader	402.64	402.64	370.45	4,598.19	3.60	990

Combustion Sources	TSP (kg/yr)	PM10 (kg/yr)	PM2.5 (kg/yr)	NOx (kg/yr)	SO2 (kg/yr)	CO (kg/yr)
Mobile Crushing Plant	509.31	509.31	468.47	4,804.80	3.71	1,576
Wheel Loader	778.38	778.38	716.40	8,504.50	5.40	2,616
T Loader	778.38	778.38	716.40	8,504.50	5.40	2,616
Genset (50kVA)	1,113.84	1,113.84	1,087.63	15,834.00	3.65	3,407
Convoy Trucks	535.81	535.81	503.78	6,784.96	4.86	1,983
Total	13,591.9	13,591.9	12,634.7	169,655.4	143	59,600

8.3.4 Operational Phase

Combustion emissions during operations include:

- mobile plant and vehicles supporting TSF operations, inspection, maintenance, and staged embankment activities; and
- stationary diesel generation supplying TSF operational power demand, including the 11 MW installed capacity diesel generation system.

Table 20 Operational Criteria Pollutants Combustion Emissions

Combustion Sources	TSP (kg/yr)	PM10 (kg/yr)	PM2.5 (kg/yr)	NOx (kg/yr)	SO2 (kg/yr)	CO (kg/yr)
Excavator (45 t)	3,575	3,575	3,267	40,360	27.9	11,070
Dozer (D8)	1,788	1,788	1,634	20,180	14.0	5,535
Diesel Generator (Genset 50kVA)	1,114	1,114	1,088	15,834	3.6	3,407
Gensets (11 MW installed capacity)	18,368	18,368	17,920	349,440	93	4.6
Crew bus (25-57 seater)	460.8	460.8	452.1	6,639	3.6	1,990
Dump Truck (20 t)	4,019	4,019	3,778	50,887	36.5	14,873
Supt Vehicle	2,595	2,595	2,400	32,432	17.3	13,319
Convoys Trucks (long haul semi-trailers)	536	536	504	6,785	4.9	1,983

Combustion Sources	TSP (kg/yr)	PM10 (kg/yr)	PM2.5 (kg/yr)	NOx (kg/yr)	SO2 (kg/yr)	CO (kg/yr)
Total	32,454	32,454	31,043	522,558	201	52,182

Combustion-related emissions for the Project were estimated based on the fuel consumption and equipment inventory described in above, using emission factors from the NPI EETM for Combustion Engines (Version 3.0, 2008). The resulting emissions are presented as annualised totals (kg/yr) for each project phase and as cumulative totals (kg) over the duration of construction and operations.

These emission estimates provide:

- a quantitative basis for comparing relative contributions of combustion sources between construction and operational phases; and
- input data for the dispersion modelling assessment where emissions are represented as time-resolved emission rates (e.g., g/s) to evaluate ground-level concentrations at sensitive receptors.

While annual emission totals are useful for comparing overall emission magnitude, potential air quality impacts are primarily governed by short-term emission rates, meteorological conditions, and proximity to receptors, which are explicitly assessed through dispersion modelling.

Table 21 Annual Combustion Emissions

Project Phase	TSP (kg)	PM10 (kg)	PM2.5 (kg)	NOx (kg)	SO2 (kg)	CO (kg)
Annual Construction	30,608	30,608	28,527	371,247	274	120,870
Annual Operations	32,454	32,454	31,043	522,558	201	52,182

Table 22 Total Combustion Emissions

Project Phase	TSP (kg)	PM10 (kg)	PM2.5 (kg)	NOx (kg)	SO2 (kg)	CO (kg)
Total Construction	91,825	91,825	85,580	1,113,740	821	362,609
Total Operations	649,076	649,076	620,854	10,451,168	4,014	1,043,634
Total	740,900	740,900	706,434	11,564,908	4,835	1,406,243

The inventory indicates that combustion-related particulate emissions are lower in magnitude than fugitive dust emissions, which is typical for large earthworks projects where dust and exposed surface sources dominate particulate mass. Combustion emissions remain important, however, because they are the primary source of NO_x (evaluated primarily as NO₂ in ambient criteria comparisons) and contribute to PM_{2.5} exposure pathways.

Across construction activities, NO_x emissions are driven by diesel equipment and vehicle fleets operating over extended periods, including excavators, dozers, dump trucks, and logistics vehicles. During the operational phase, the dominant combustion contributor is the on-site diesel power generation system (up to 11 MW installed capacity), which represents a continuous and centralised emissions source relative to more dispersed mobile equipment activities.

The emissions inventory results presented in this section are used to inform both the relative contribution of combustion sources by phase and the source inputs used in dispersion modelling to evaluate potential impacts at sensitive receptors.

8.4 DISPERSION MODELLING RESULTS

The emissions inventory quantifies pollutant releases as mass emissions (e.g., kg/yr). Dispersion modelling then translates those emissions into ambient air concentrations ($\mu\text{g}/\text{m}^3$) at locations where people and ecosystems may be exposed. This distinction is important: emissions are a source term, whereas concentrations are the exposure metric used in ambient air quality guidelines and criteria. Accordingly, the quantitative impact assessment is based on modelled concentrations at sensitive receptors and across the surrounding area, which are then compared against the adopted ambient air quality criteria.

AERMOD requires emission inputs as mass emission rates (typically g/s) for each modelled source. Annualised emissions from the inventory were therefore converted to representative emission rates for modelling, consistent with the approach described in the draft modelling section.

For sources treated as continuous or representative average sources, the conversion is performed by distributing the annual mass over the applicable operating time. In general terms:

Emission rate (g/s) = Annual emissions (kg/yr) $\times$ 1,000 (g/kg) $\div$ Operating hours (to seconds) per year

Where sources operate continuously, operating seconds are based on 365 days $\times$ 24 hours $\times$ 3,600 seconds. Where sources are intermittent but modelled conservatively as representative continuous sources, operating time reflects the selected modelling scenario assumptions (e.g., a representative “active period” for construction or continuous operation for stationary generators). This conversion step provides a consistent basis for deriving model inputs from the annual inventory while allowing concentration outputs to be evaluated against short-term and annual criteria.

In addition to evaluating concentrations at discrete sensitive receptor locations, the dispersion modelling also incorporates a receptor grid covering the full modelling domain. This grid enables the identification of maximum predicted concentrations, which may occur between discrete receptor points or in areas not directly represented by individual receptors.

Identification of these maximum concentrations is important for:

- ensuring that the highest potential impacts are captured, regardless of their location;
- supporting a conservative and comprehensive assessment of air quality impacts; and
- confirming that compliance with adopted criteria is achieved across the entire project area, not solely at predefined receptor locations.

Accordingly, both maximum modelled concentrations and concentrations at sensitive receptors are considered in the assessment to provide a robust and defensible evaluation of potential air quality impacts.

8.4.1 Treatment of NO_x and Focus on NO₂ for Impact Evaluation

The emissions inventory quantifies NO_x as a combined emission category from combustion sources (Section 7.3). Ambient air quality criteria, however, are typically defined for nitrogen dioxide (NO₂) rather than total NO_x, because NO₂ is the form most directly associated with health-based guideline development and compliance frameworks.

In the atmosphere, NO_x emissions are initially dominated by nitric oxide (NO) with a smaller fraction as NO₂, and then chemical reactions convert some NO to NO₂ downwind of the source. As a result, dispersion modelling outputs for NO_x (or NO₂ as an indicator) are commonly translated to NO₂ using established screening or tiered approaches, depending on available data and the conservatism required. Common

approaches include (i) Total Conversion (100% of NO_x assumed to be NO₂) as a conservative screening method, and (ii) Tier 2 approaches that apply a fixed conversion fraction (e.g., 75%) when a less conservative but still protective estimate is warranted.

For this assessment, the evaluation of combustion impacts is presented primarily in terms of NO₂ concentrations, consistent with the adopted ambient criteria and the purpose of the impact assessment (exposure-based evaluation). The modelling section should clearly state the selected 100 % NO_x→NO₂ conversion approach applied to the AERMOD outputs, and the resulting concentration results should be reported as NO₂ for comparison against criteria.

8.4.2 Source Representation and Spatial Distribution of Emissions

Emission sources were represented in the dispersion model using a combination of area, line, and point sources to reflect the physical nature, spatial extent, and duration of project activities.

TSF construction - particulate emissions (area source representation)

For TSF construction, particulate emissions were conservatively represented as an area source covering the full TSF construction footprint, acknowledging that in reality the TSF will be constructed progressively in stages. The total particulate emission rate for the TSF construction scenario was spatially distributed across the entire modelled construction area, meaning the annualised mass is not emitted from a single point but is apportioned across the area of active works. This approach is important for interpretation: even when the total annual emission load is large, the corresponding emission rate per unit area is lower at any given location, and predicted concentrations at off-site receptors reflect this distributed release mechanism.

Infrastructure corridor construction - particulate emissions (line/distributed representation)

Emissions associated with pipeline and access road construction were calculated on a per-kilometre basis and represented in the dispersion model as a 1-kilometre line source, reflecting a representative segment of the infrastructure corridor. The calculated emissions were uniformly distributed along the length of the modelled segment, consistent with the assumption that construction activities progress sequentially along the corridor and that emission intensity is broadly similar per unit length of active works.

This representation assumes that emissions are evenly distributed along the corridor alignment, regardless of local variations in land cover (e.g., densely vegetated areas versus cleared sections), and therefore provides a simplified but conservative approximation of emission release conditions during active construction. As a result, emissions are released over a relatively narrow spatial extent compared to area sources, and in many locations occur in very close proximity to receptors, with some residential receptors located at distances of less than 10 metres from the construction footprint and access routes.

This proximity, combined with the distributed nature of emissions along the corridor, can result in elevated near-field concentrations at individual receptor locations, even where total annualised emission loads are similar to or lower than those associated with more spatially extensive sources such as the TSF construction area.

Project operations - combustion emissions (point source representation)

Operational emissions from on-site diesel generators were modelled as point sources operating continuously, reflecting the fixed location and semi-continuous (Diesel Generator - Genset 50kVA) to continuous (Gensets - 11 MW installed capacity) nature of power generation during operations. This representation typically drives the assessment of annual-average NO₂ because the emissions are persistent rather than short-term and mobile. The following parameters were modelled for the semicontinuous generators and the continuous generators.

- Semicontinuous Generator (Genset 50kVA)
 - Exhaust temperature: 315 C
 - Stack Height: 50 m
 - Stack Diameter: 15 cm
- Continuous Generator (11 MW)
 - Exhaust temperature: 315 C
 - Stack Height: 3 m
 - Stack Diameter: 15cm

8.4.3 Particulate Matter Concentrations

Annualized emissions associated with construction activities and combustion sources were converted to representative mass emission rates (g/s) and applied as input parameters for air dispersion modelling using AERMOD.

Tables 23 and 24 summarise the maximum predicted 24-hour and annual average concentrations of TSP, PM_{2.5}, and PM₁₀ for the construction and operation of the TSF and infrastructure corridor.

These maximum values are derived from the full receptor grid and represent the highest concentrations predicted anywhere within the modelling domain, independent of discrete receptor locations. As such, they provide a conservative upper bound on potential impacts and confirm that all other receptor grid points and identified sensitive receptors experience equal or lower concentrations.

Consistent with this, the maximum predicted concentrations are used as a reference for comparison with the adopted ambient air quality criteria, while concentrations at sensitive receptors (presented in the following tables) provide a site-specific evaluation of potential impacts at locations of human and environmental relevance.

Contour plots have been developed to illustrate the spatial extent of predicted particulate matter concentrations across the modelling domain. Given that predicted PM₁₀ and PM_{2.5} concentrations are consistently equal to or lower than TSP, and exhibit the same spatial distribution, contour plots are presented for TSP only. These contours therefore represent the maximum extent of particulate matter impacts under the assessed scenarios.

Contours presented in Figures 7-1 to 7-3 show the spatial extent of short-term TSP (24-hour) impacts from TSF construction, TSF operations, and infrastructure corridor construction, while Figures 7-4 to 7-6 show the spatial extent of long-term (annual average) impacts for the same project components..

Table 23 Short Term Predicted Concentrations and Adopted Ambient Air Quality Criteria

	TSF Construction ($\mu\text{g}/\text{m}^3$)	Project Operations ($\mu\text{g}/\text{m}^3$)	Infrastructure Corridor Construction ($\mu\text{g}/\text{m}^3$)	Short Term Impacts Adopted Criteria ($\mu\text{g}/\text{m}^3$)
TSP	0.69	1.48	3.56	150
PM₁₀	0.69	1.48	1.57	45
PM_{2.5}	0.67	1.44	0.26	15

Table 24 Long Term Predicted Concentrations and Adopted Ambient Air Quality Criteria

	TSF Construction ($\mu\text{g}/\text{m}^3$)	Project Operations ($\mu\text{g}/\text{m}^3$)	infrastructure Corridor Construction ($\mu\text{g}/\text{m}^3$)	Long Term Impacts Adopted Criteria ($\mu\text{g}/\text{m}^3$)
TSP	0.13	0.32	0.26	75
PM₁₀	0.13	0.32	0.11	15
PM_{2.5}	0.13	0.31	0.02	5

As shown in tables 23 and 24 and the concentration contours presented below all maximum impacts and, therefore, all receptors comply with the adopted ambient air quality criteria. In this assessment, maximum impacts occur in close proximity to emission sources and represent near-field conditions, while concentrations at sensitive receptors are lower due to distance and dispersion effects.

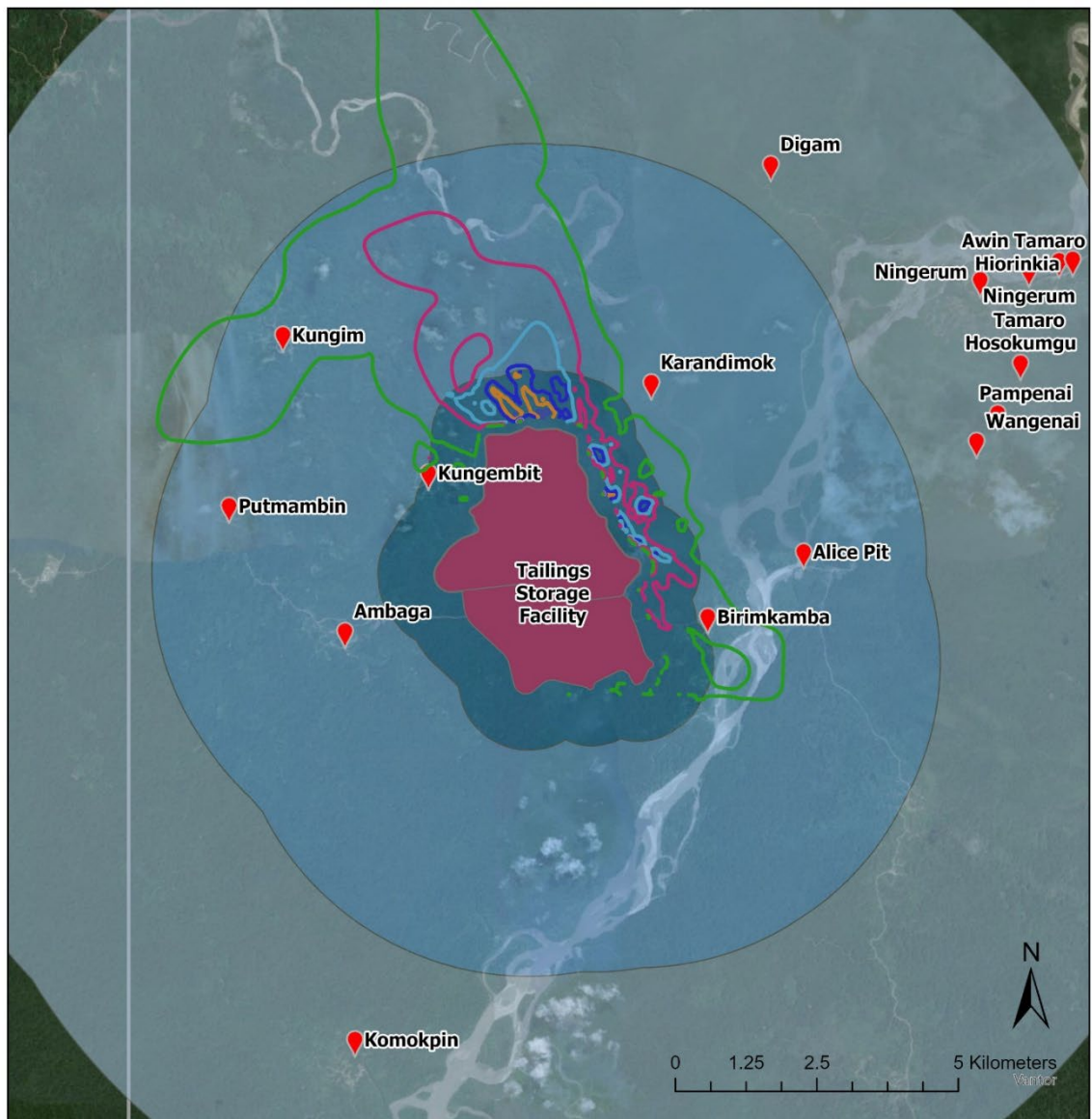
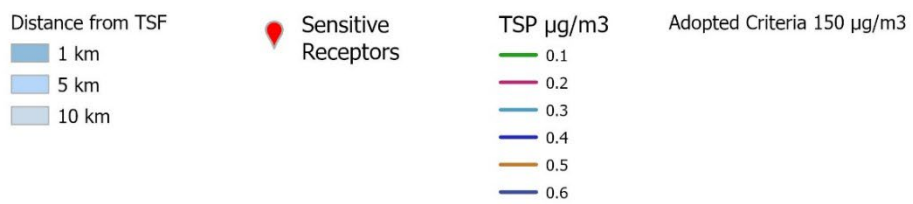


Figure 7-1 24-hour TSP predicted concentrations from TSF construction of the TSF development area

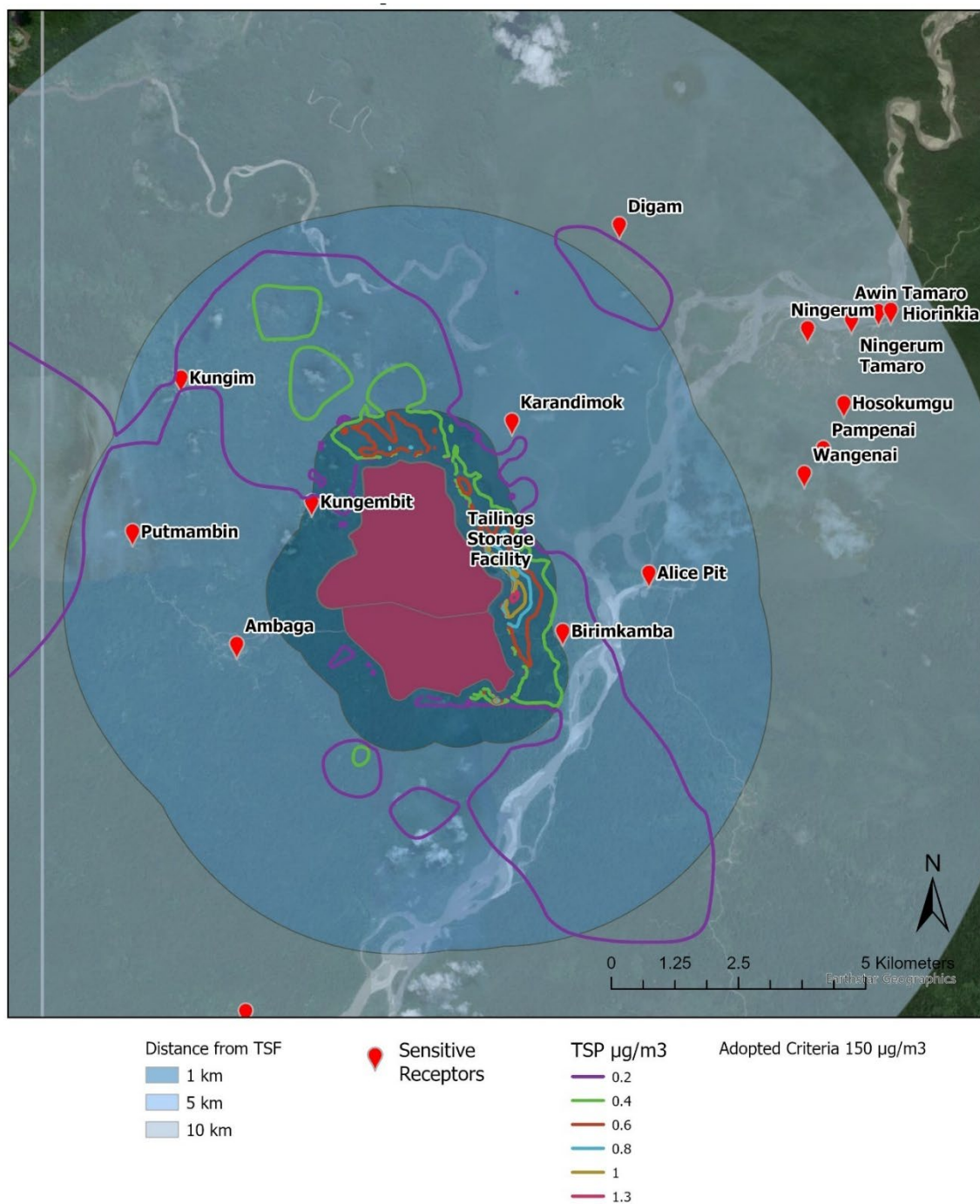


Figure 7-2. 24-hour TSP predicted concentrations from the operations of the TSF development area

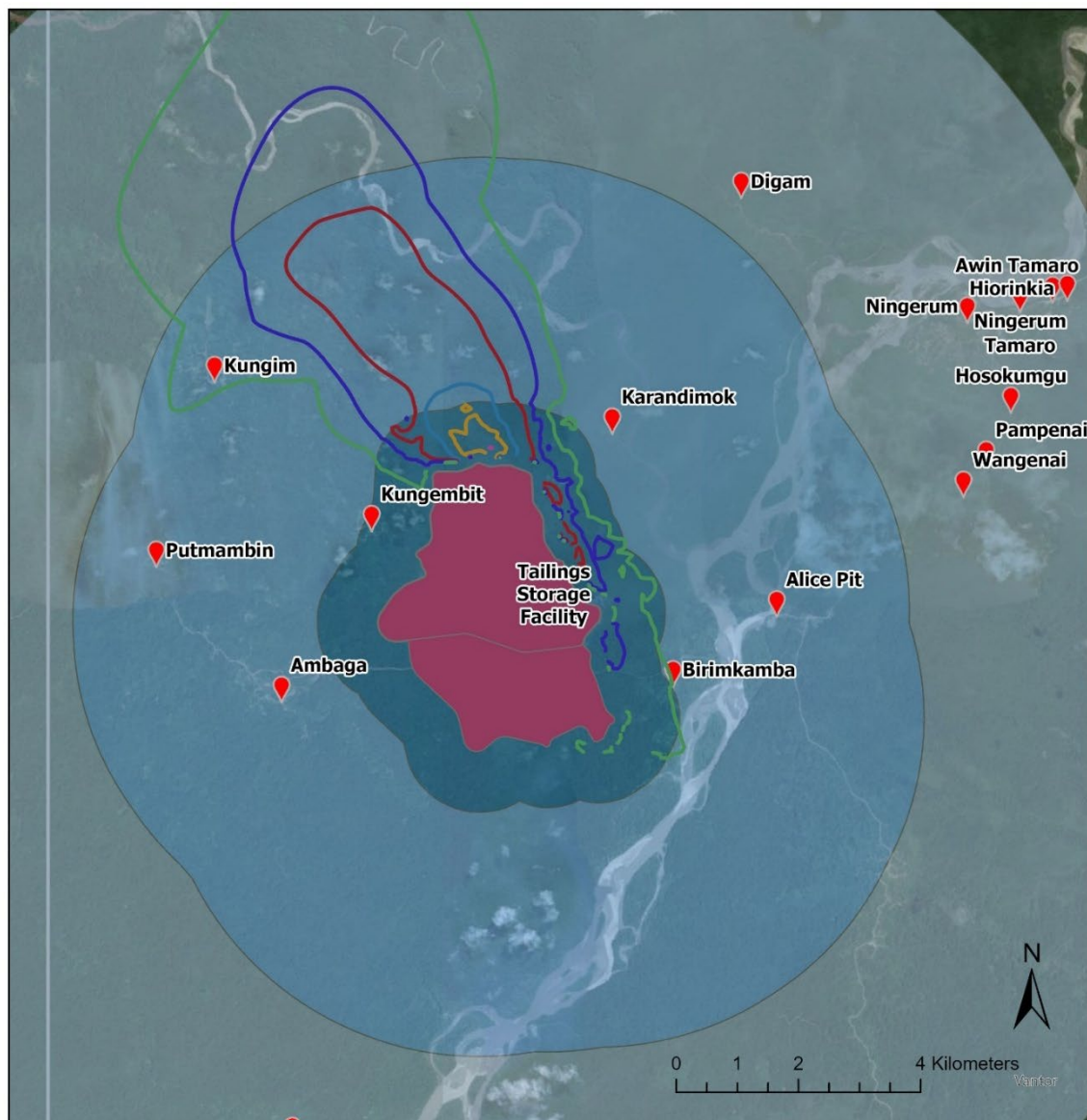


Figure 7-3 Annual TSP predicted concentrations from the construction of the TSF development area

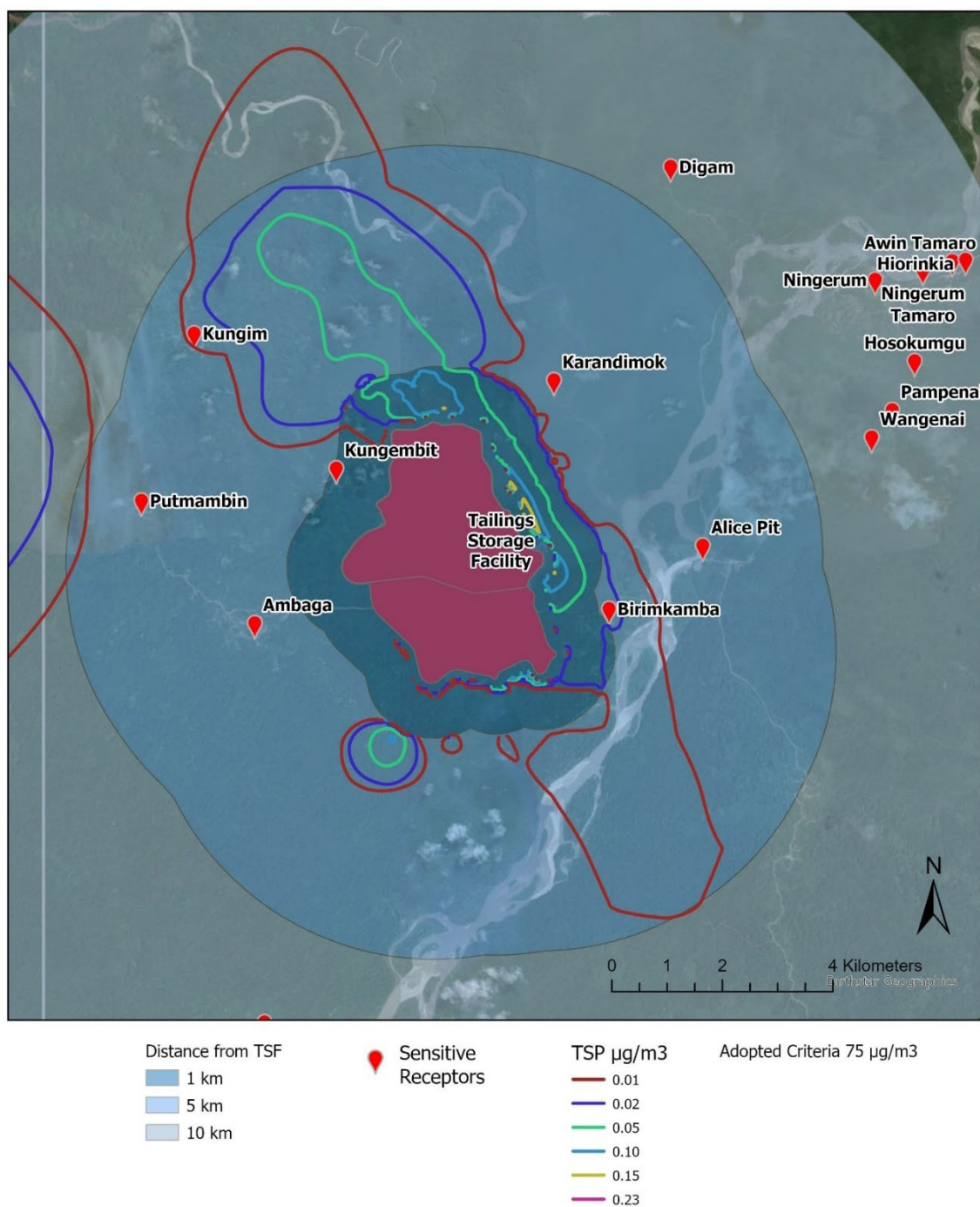


Figure 7-4 Annual TSP predicted concentrations from the operations of the TSF development area

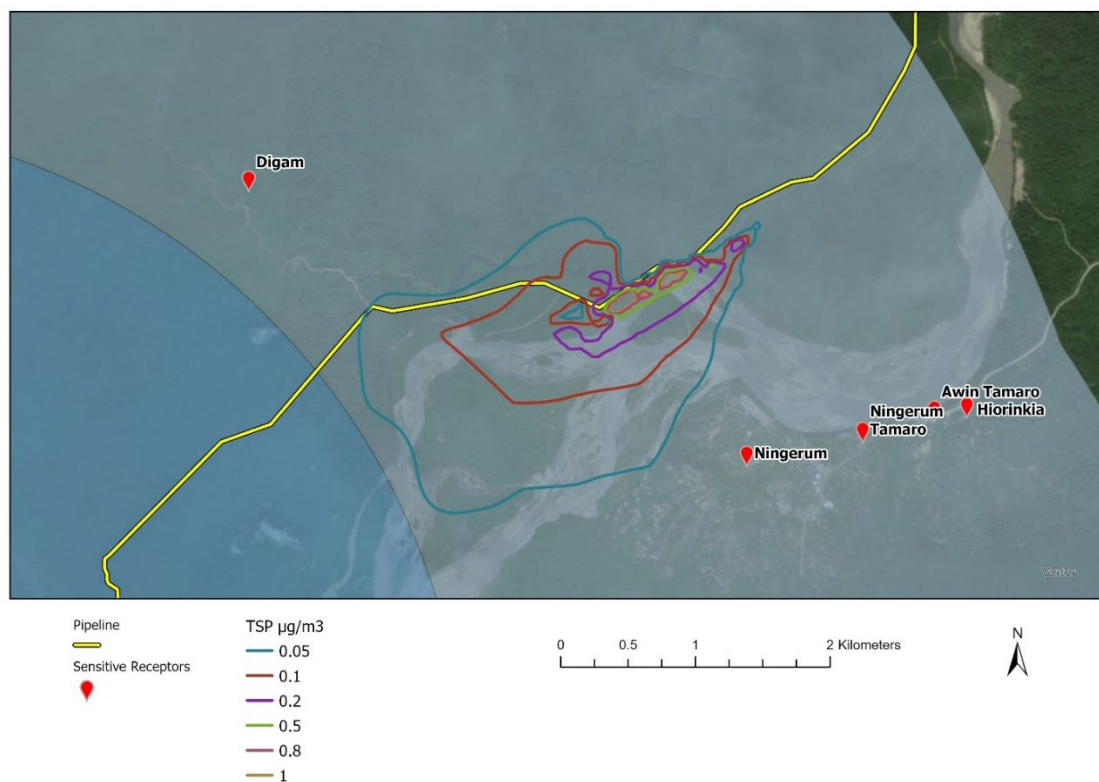


Figure 7-5. 24-hour TSP predicted concentrations from the construction of 1km of infrastructure

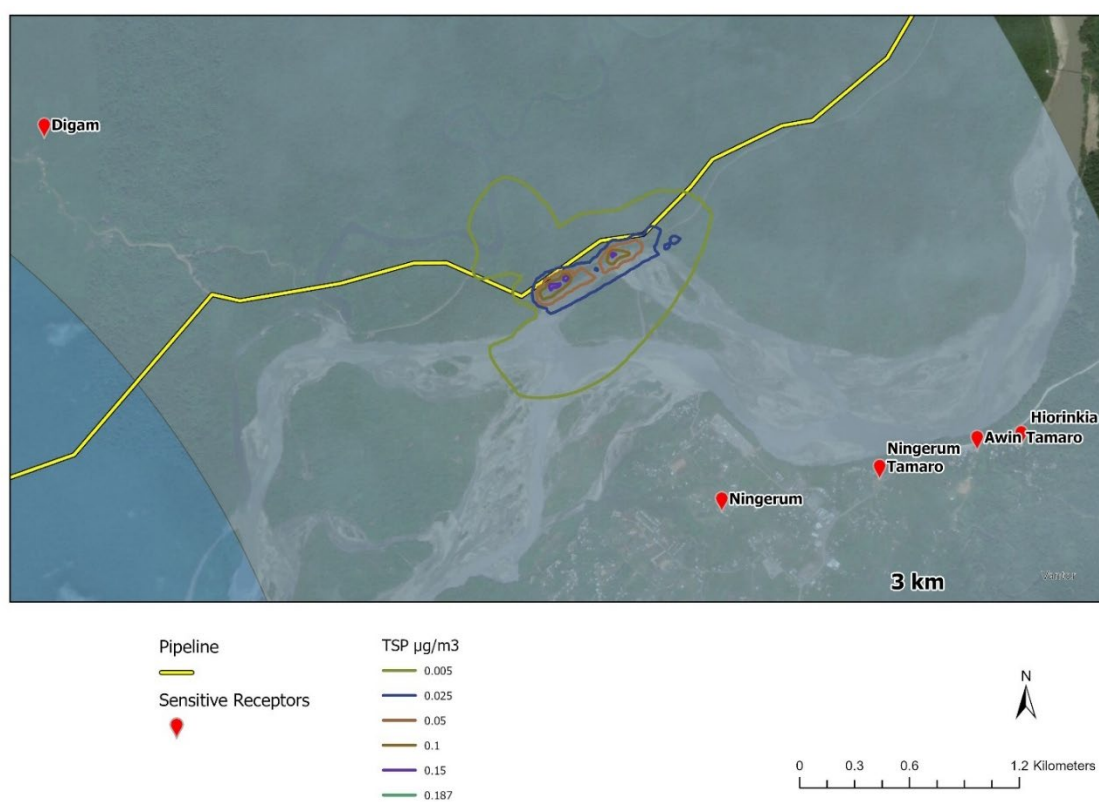


Figure 7-6. Annual TSP predicted concentrations from the construction of 1km of infrastructure

8.4.4 NO₂ Concentrations

Annualised combustion emissions from diesel use in generators and mobile equipment were converted to representative emission rates (g/s) and applied as input parameters for dispersion modelling using AERMOD.

Table 25 summarise the maximum predicted 1-hour and annual average NO₂ concentrations for construction and operational activities associated with the TSF and infrastructure corridor.

Consistent with the approach described above, these values are derived from the full receptor grid and represent the highest concentrations predicted anywhere within the modelling domain, independent of specific receptor locations. As such, they provide a conservative upper bound on potential impacts, confirming that all other receptor grid points and identified sensitive receptors experience equal or lower concentrations.

The maximum predicted concentrations are therefore used as a reference for comparison against the adopted ambient air quality criteria, while concentrations at sensitive receptors (presented in the following tables) provide a more localized assessment of potential exposure at community and environmental receptor locations.

Contours presented below show the spatial extent of short-term (24-hour) impacts for the construction and operation of the TSF. Given that annual average concentrations are uniformly low and remain well below the adopted ambient air quality criteria across the modelling domain, contour plots for long-term impacts are not presented for clarity and brevity, as they do not provide additional interpretative value beyond the tabulated results.

Table 25 Short Term Predicted Concentrations and Adopted Ambient Air Quality Criteria

	TSF Construction (µg/m³)	TSF Operations (µg/m³)	Infrastructure Corridor Construction (µg/m³)	Adopted Criteria (µg/m³)
NO₂ (1 hour)	63.58	112.3	6.85	188
NO₂ (Annual)	1.83	5.05	0.11	100

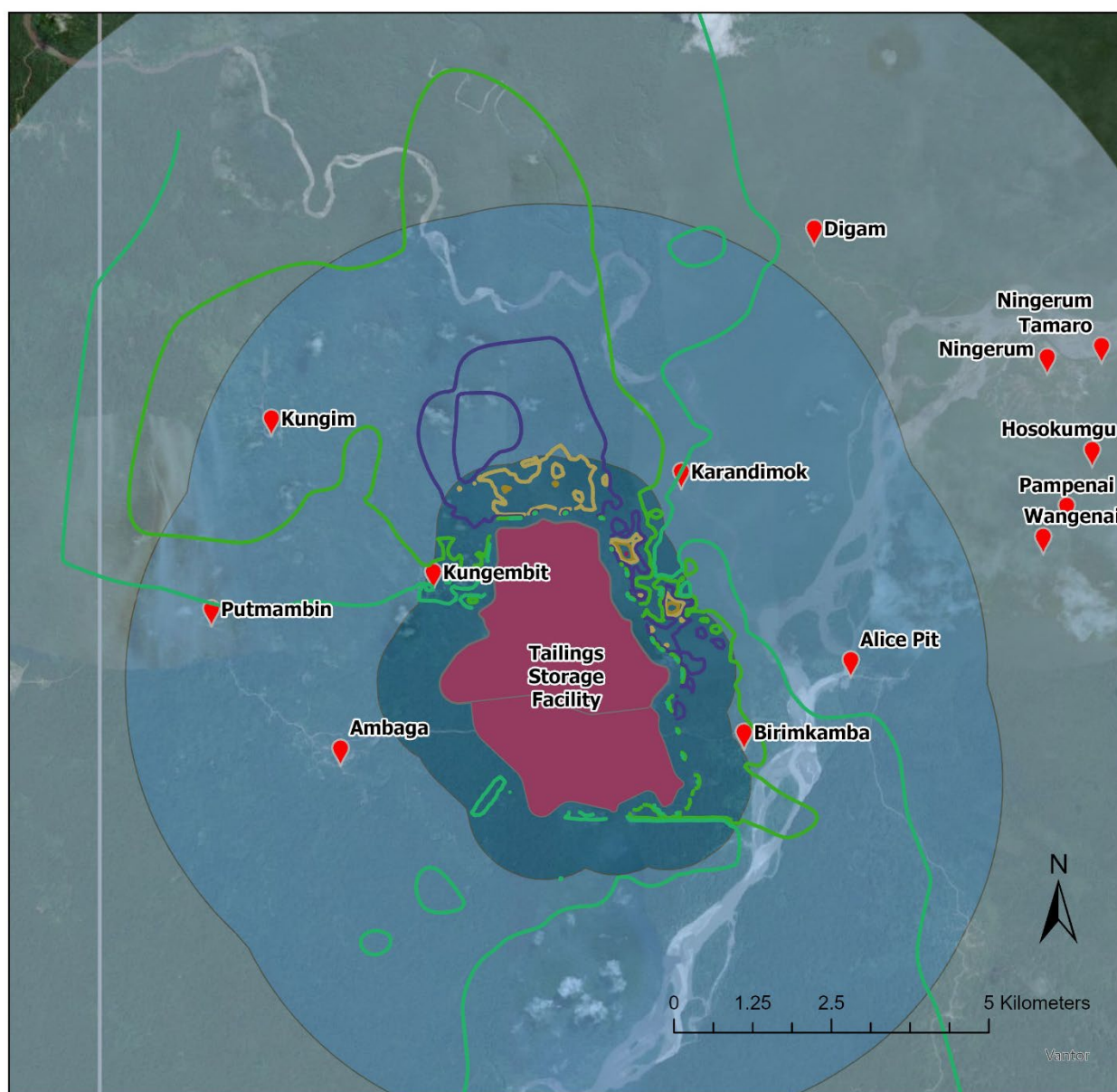
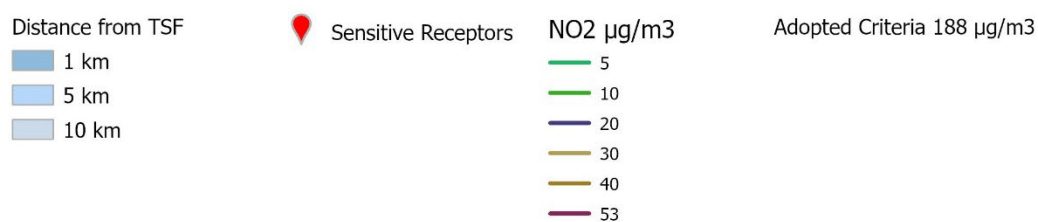


Figure 7-7 1-hour NO₂ predicted concentrations from the construction of the TSF development area

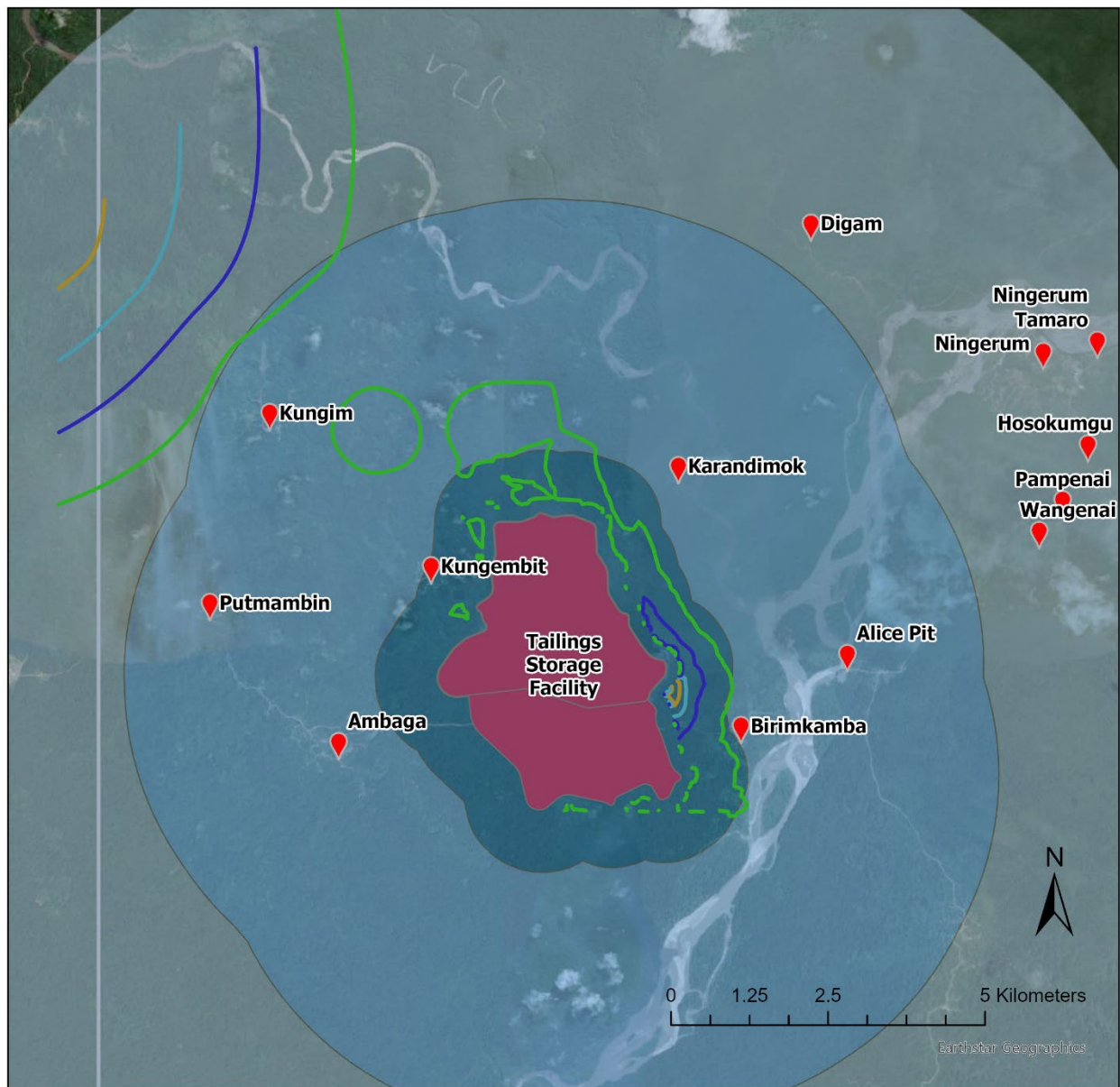
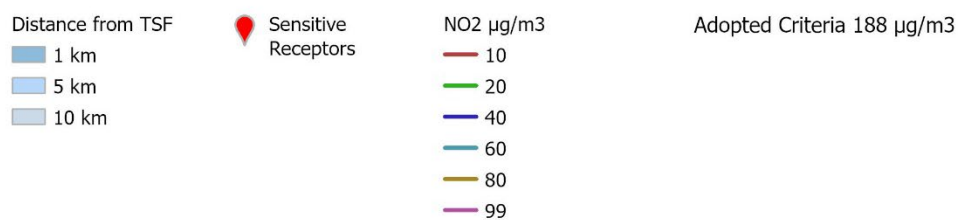


Figure 7-8 1-hour NO₂ predicted concentrations from the operations of the TSF development area

9. QUANTITATIVE AND QUALITATIVE ASSESSMENTS

9.1 QUALITATIVE IMPACT ASSESSMENT

9.1.1 Infrastructure Corridor Construction Impacts

9.1.1.1 Dust Emission Magnitude

Infrastructure corridor construction activities, including trenching, spoil handling, backfilling, and construction traffic, are estimated to generate particulate emissions of approximately:

- 0.85 kg/hr/km of Total Suspended Particulates (TSP), and
- 0.44 kg/hr/km of PM₁₀

during periods of active construction. These emission rates represent elevated short-term dust generation intensity, particularly where multiple activities occur concurrently along linear sections of the alignment. Estimated PM_{2.5} emissions of approximately 0.09 kg/hr/km further indicate the presence of fine particulate matter, although the IAQM qualitative methodology focuses on PM₁₀ for construction dust assessment.

Given the linear nature of the works and the sustained daily duration of trenching and construction traffic, the dust emission magnitude for the infrastructure corridor construction is classified as Medium, in accordance with IAQM definitions for infrastructure projects of this type.

9.1.1.2 Receptor Sensitivity

The infrastructure corridor alignment passes in close proximity to villages and residential areas in several locations such as Tabubil, Wangbin, Seven Kona, Kumkit/Amkit, Ok Teditau, Ningerum, Ningerum Tamaro, Awin Tamaro, and Hiorinkia dwellings and community receptors are located adjacent to active construction works and the pipeline access road, resulting in continuous near-field exposure during working hours.

Given the estimated PM₁₀ emission rates and the very short separation distances, nearby receptors are considered highly sensitive to:

- Dust deposition effects, due to direct deposition of coarse and intermediate particles on properties, vegetation, and outdoor surfaces; and
- Human health effects, due to elevated short-term PM₁₀ concentrations in the immediate vicinity of construction activities.

Consistent with IAQM guidance, residential communities in close proximity to construction activities are therefore classified as High sensitivity receptors.

9.1.1.3 Unmitigated Risk of Dust Impacts

For pipeline construction, the combination of:

- Medium dust emission magnitude (PM₁₀ ≈ 0.41 kg/hr/km under peak construction conditions), and
- High receptor sensitivity (villages and houses located within only a few metres of works),

results in an overall unmitigated dust risk classification of HIGH for both:

- Dust soiling (amenity) impacts, and
- Human health impacts associated with PM₁₀ exposure.

This outcome is consistent with IAQM risk matrices for linear construction projects with elevated short-term emissions occurring in immediate proximity to residential receptors.

9.1.1.4 Mitigation and Residual Effects

In accordance with IAQM guidance, if enhanced and site-specific mitigation measures are to be implemented along the infrastructure corridor to control dust emissions, including dust suppression as needed during extended dry periods, strict traffic controls, minimisation of exposed surfaces, progressive rehabilitation and revegetation of disturbed areas, management of material carry over from construction areas onto access routes (track-out), as well as phased construction through populated areas then the intensity and duration of exposure will be substantially reduced.

Collectively, these measures are expected to reduce both the intensity and duration of dust exposure at nearby receptors. However, due to the combination of elevated short-term emission rates during peak construction activities and very close proximity of sensitive receptors to sections of the works, some temporary and localised dust effects may still occur.

From a qualitative perspective and following the implementation of mitigation measures:

- Residual dust impacts are assessed as Low to Medium, and
- Impacts are expected to be localised, short-term, and manageable with the application of appropriate controls.

9.1.2 TSF Construction Impacts

9.1.2.1 Dust Emission Magnitude

Even with baseline dust controls, including an assumed 75% reduction effectiveness due to the very high rainfall in the region, TSF construction has the potential to generate high short-term particulate emissions.

Calculated construction emissions for the TSF are approximately:

- Total PM₁₀: ~94.4 kg/hr
(dominant contribution from mechanically generated dust sources: ~91.4 kg/hr), and
- Total TSP: ~320 kg/hr
(dominant contribution: ~317 kg/hr).

These values indicate a large dust emission magnitude under IAQM criteria.

9.1.2.2 Receptor Sensitivity

The nearest communities are located within the 1km and 5 km impacts area including Kungembit, Birimkamba, Ambaga, Putmambin, Karandimok, Alice Pit and Kungim. At this distance, receptors are within the zone where construction dust can reasonably cause:

- Dust soiling (amenity) impacts, particularly from coarse and intermediate dust fractions (TSP); and
- Human health impacts, associated with short-term PM₁₀ exposure.

Given that these are residential and community receptors within IAQM screening distances, the surrounding area is classified as High sensitivity for both dust soiling and human health considerations, particularly where construction activities are prolonged or recurring.

9.1.2.3 Unmitigated Risk of Dust Impacts

For TSF construction, the combination of:

- Large dust emission magnitude, and

- High receptor sensitivity,

results in an overall unmitigated dust risk classification of HIGH for:

- Dust soiling (amenity) impacts, and
- PM₁₀-related human health impacts.

9.1.2.4 Mitigation and Residual Effects

Given the High unmitigated risk, OTML will implement a comprehensive dust mitigation strategy, including dust suppression, stabilization of exposed areas, stringent haul road controls, track-out management, and operational controls during adverse conditions. These measures will be supported by adaptive management practices, including routine visual inspections, trigger-based dust suppression, traffic and activity management, and responsive actions based on site conditions and community feedback, to ensure effective control of dust emissions in proximity to sensitive receptors.

Following the application of these mitigation measures, and consistent with IAQM guidance:

- The intensity, spatial extent, and duration of dust emissions will be substantially reduced.
- Some short-term, localized dust effects may still occur during peak activity periods, particularly under unfavorable meteorological conditions.
- Such effects are expected to be temporary, intermittent, and confined to the construction period.

Taking into account the effectiveness of mitigation and remaining receptor proximity, the residual risk of dust impacts from TSF construction is assessed as Low to Medium. Residual impacts are not expected to be significant, provided that mitigation measures are effectively implemented, monitored, and adaptively managed throughout the construction phase.

Overall, from a qualitative perspective and if appropriate controls are put in place, construction-related dust impacts from TSF development are temporary, and manageable, and are not anticipated to result in long-term adverse effects on nearby communities.

Table 26 summarizes the qualitative risk assessment from construction activities related to the infrastructure corridor and TSF.

Table 26 IAQM Qualitative Dust Impact Assessment Results Matrix (Construction Phase)

Project Component	IAQM Activity Type	Dust Emission Magnitude (Step 2A)	Receptor Sensitivity (Step 2B)	Unmitigated Dust Risk (Step 2C)	Residual Dust Risk (Step 4)
Infrastructure corridor	Earthworks / Construction / Track-out	Medium	High (Residences & villages immediately adjacent to works)	High (Amenity & PM ₁₀ health impacts)	Low–Medium (temporary, localized, manageable with mitigation)
TSF	Earthworks / Construction / Track-out	Large	High (Communities ~190 m from TSF footprint)	High (Amenity & PM ₁₀ health impacts)	Low–Medium (temporary, intermittent; controlled through enhanced mitigation)

- The IAQM qualitative assessment applies only to construction dust (PM₁₀ and coarser fractions).
- Unmitigated risk reflects conditions prior to the application of site-specific dust controls.
- Residual risk reflects impacts after implementation of enhanced IAQM-appropriate mitigation measures, including regular dust suppression during dry periods, traffic and haul-road controls, stabilization of exposed surfaces, and operational controls during adverse conditions.
- Residual impacts are not significant, provided mitigation measures are effectively implemented and managed throughout construction.

9.2 QUANTITATIVE IMPACT ASSESSMENT

A quantitative assessment was undertaken to evaluate potential air quality impacts associated with emissions of nitrogen oxides (NO_x) and particulate matter (PM₁₀ and PM_{2.5}) generated during:

- Construction of the TSF;
- Construction of the infrastructure corridor; and
- Project operations.

The assessment focused on pollutants with the greatest potential to result in off-site air quality impacts, namely particulate matter from fugitive dust sources and NO_x from diesel-powered mobile and stationary combustion sources. Emissions were estimated using a conservative emissions inventory developed from project activity data, fuel consumption estimates, and published emission factors. Predicted ground-level concentrations of NO₂, PM_{2.5} and PM₁₀ were evaluated at sensitive receptors identified in the vicinity of the project area and compared against relevant ambient air quality criteria.

The air quality assessment has been focused on particulate matter (TSP, PM₁₀, PM_{2.5}) and nitrogen dioxide (NO₂) as these pollutants represent the most relevant indicators of potential impacts associated with the Project's emission sources. Particulate matter is the primary pollutant associated with construction-related activities, including earthworks, material handling, and unsealed road traffic, and therefore governs short-term amenity and health considerations. During operations, emissions are dominated by diesel combustion from on-site power generation, for which NO₂ is the key pollutant of concern for both short-term and long-term exposure.

Other pollutants such as carbon monoxide (CO) and sulfur dioxide (SO₂) were evaluated as part of the emissions inventory and screening assessment. These pollutants are generated in small quantities compared to particulate matter and NO_x, and predicted concentrations are low in absolute terms and well below the adopted ambient air quality criteria. Accordingly, they do not represent limiting factors in the assessment, and the evaluation focuses on the pollutants most relevant to potential impacts.

9.2.1 Constructions Activities

9.2.1.1 Predicted Particulate Matter Impacts

As shown by the air dispersion modelling results in Tables 23 and 24, particulate matter impacts from both TSF construction and infrastructure corridor construction are measurable but low in absolute concentration, with the reported values representing the maximum predicted concentrations across the full receptor grid. These maximum values define a conservative upper bound on potential impacts, confirming that concentrations at all identified sensitive receptors are equal to or lower than these values.

While TSF construction is classified as a Large dust emission magnitude under the IAQM framework due to the scale, duration, and extent of earthworks, the quantitative modelling demonstrates that the resulting 24-

hour and annual average concentrations of TSP, PM₁₀, and PM_{2.5} remain well below the adopted ambient air quality criteria throughout the modelling domain.

Similarly, for infrastructure corridor construction, maximum predicted short-term concentrations (e.g., up to 3.56 µg/m³ for TSP and 1.57 µg/m³ for PM₁₀) and annual average concentrations (e.g., 0.26 µg/m³ for TSP and 1.57 µg/m³ for PM₁₀) are also well below the adopted ambient air quality criteria, confirming a substantial margin of compliance. These results are based on a conservative modelling representation of the corridor as a continuous 1 km line source applied along the entire infrastructure corridor area, which effectively assumes simultaneous activity along the alignment. As such, the predicted concentrations are considered representative of worst-case conditions along the corridor, and confirm that all sensitive receptors along the infrastructure corridor would also experience concentrations below the adopted ambient air quality criteria.

This outcome reflects the fact that emissions from both TSF construction and the infrastructure corridor are distributed across broad or linear active work areas rather than concentrated at a single point source, resulting in lower off-site concentrations despite the overall emission magnitude. Short-term impacts are driven by construction activity intensity and are temporally variable, peaking during active earthworks under dry conditions, while long-term (annual average) impacts remain minimal for both project components.

In addition, due to the transient nature of infrastructure corridor construction, potential exposure at any individual receptor is limited to relatively short durations (typically days to weeks), rather than continuous or repeated exposure over extended periods. As a result, annual average PM₁₀ and PM_{2.5} concentrations attributable to infrastructure corridor construction remain well below the adopted ambient air quality criteria at all receptors.

9.2.1.2 Predicted NO₂ Impacts

NO_x emissions from diesel-powered construction equipment are used as input to dispersion modelling, which predicts ambient concentrations that are assessed as NO₂ for comparison with the adopted ambient air quality criteria. Dispersion modelling indicates that maximum predicted NO₂ concentrations associated with TSF construction and infrastructure corridor construction remain below the adopted ambient air quality criteria for both short-term (1-hour) and long-term (annual) averaging periods.

Specifically, the maximum predicted 1-hour NO₂ concentrations are 63.58 µg/m³ for TSF construction and 6.85 µg/m³ for infrastructure corridor construction, compared to an adopted ambient air quality criterion of 188 µg/m³. Similarly, maximum annual average NO₂ concentrations are predicted to be 1.83 µg/m³ (TSF construction) and 0.11 µg/m³ (infrastructure corridor construction), compared to an adopted annual ambient air quality criterion of 100 µg/m³.

These maximum values are derived from the full receptor grid and represent the highest predicted concentrations anywhere within the modelling domain, providing a conservative upper bound on potential impacts. As such, they confirm that concentrations at all identified sensitive receptors are equal to or lower than these values, and therefore remain below the adopted ambient air quality criteria. For the infrastructure corridor, this interpretation is further supported by the conservative modelling representation of a continuous line source applied along the alignment, such that the predicted maximum concentrations are considered representative of worst-case conditions and applicable across the entire corridor extent.

9.2.2 Operational Phase

9.2.2.1 Predicted Particulate Matter Impacts

Operational PM₁₀ and PM_{2.5} impacts are associated primarily with fugitive dust from exposed TSF surfaces during dry conditions and traffic on unsealed operational roads. Potential dust lift-off from TSF surfaces is recognised as a key concern for nearby communities and has been explicitly considered in the assessment

through estimation of wind-driven fugitive emissions and dispersion modelling of particulate matter concentrations.

The modelling indicates that particulate matter concentrations at off-site receptors, including the nearest sensitive receptors, are lower than those predicted during construction and remain below applicable short-term and long-term air quality criteria. This reflects the distributed nature of emissions across the TSF surface and the influence of local climatic conditions, where frequent rainfall, high humidity, and surface wetting are expected to limit the persistence of dry, erodible conditions associated with dust lift-off.

Overall, particulate matter contributes a secondary component to operational phase impacts when compared to combustion-related pollutants. PM impacts are episodic and meteorologically dependent, whereas NO_x emissions contribute more consistently to long-term exposure. On this basis, operational dust from the TSF is not expected to result in significant human health impacts at nearby communities, although it remains an important consideration for ongoing operational management.

9.2.2.2 Predicted NO₂ Impacts

NO_x emissions from on-site diesel-powered equipment, particularly the 11 MW diesel power generation plant, are incorporated into dispersion modelling to predict ambient concentrations, which are assessed as NO₂ for comparison with the adopted ambient air quality criteria. Dispersion modelling indicates that predicted NO₂ concentrations associated with TSF operations remain below the adopted ambient air quality criteria for both short-term (1-hour) and long-term (annual) averaging periods.

The maximum predicted 1-hour NO₂ concentration is 112.3 µg/m³, and the maximum annual average concentration is 5.05 µg/m³, compared to adopted ambient air quality criteria of 188 µg/m³ (1-hour) and 100 µg/m³ (annual), respectively. These results demonstrate a substantial margin of compliance for both averaging periods.

These maximum concentrations are derived from the full receptor grid and represent the highest predicted values within the modelling domain, occurring in proximity to emission sources. As such, they provide a conservative upper bound on potential impacts and confirm that concentrations at all identified sensitive receptors are equal to or lower than these values and remain below the adopted ambient air quality criteria.

The results also indicate that operational NO₂ concentrations are predominantly driven by emissions from the on-site power generation system, with the 11 MW diesel plant contributing the vast majority of total NO_x emissions. Despite this, the resulting ambient concentrations remain low in absolute terms and are not expected to result in significant air quality impacts at nearby communities.

The table below summarises the compliance status of all sensitive receptors identified for the TSF development area. For each receptor, predicted concentrations of TSP, PM₁₀, PM_{2.5}, and NO₂ were assessed against the adopted ambient air quality criteria for all relevant averaging periods. As discussed in the preceding sections, all predicted concentrations at the identified sensitive receptors were below the adopted ambient air quality criteria.

Table 27 Compliance status of sensitive receptors identified for the TSF development area

Sensitive Receptor	TSP	PM ₁₀	PM _{2.5}	NO ₂
Adopted ambient air quality criteria	24-hour: 150 µg/m ³ ; Annual: 75 µg/m ³	24-hour: 45 µg/m ³ ; Annual: 15 µg/m ³	24-hour: 15 µg/m ³ ; Annual: 5 µg/m ³	1-hour: 188 µg/m ³ ; Annual: 100 µg/m ³
Tarubitis	Complies	Complies	Complies	Complies
Bingkwuk	Complies	Complies	Complies	Complies
Kungim	Complies	Complies	Complies	Complies
Kungembit	Complies	Complies	Complies	Complies
Putmambin	Complies	Complies	Complies	Complies
Patung Soekarno PLB	Complies	Complies	Complies	Complies
Yetekun	Complies	Complies	Complies	Complies
Ambaga	Complies	Complies	Complies	Complies
Komokpin	Complies	Complies	Complies	Complies
Karandimok	Complies	Complies	Complies	Complies
Birmkamba	Complies	Complies	Complies	Complies
Alice Pit	Complies	Complies	Complies	Complies
Ningerum	Complies	Complies	Complies	Complies
Awin Tamaro	Complies	Complies	Complies	Complies
Hiorinkia	Complies	Complies	Complies	Complies
Hosokumgu	Complies	Complies	Complies	Complies
Pampenai	Complies	Complies	Complies	Complies
Wangenai	Complies	Complies	Complies	Complies
Mendua	Complies	Complies	Complies	Complies
Mimingiri	Complies	Complies	Complies	Complies

The table below summarises the compliance status of all sensitive receptors identified for the infrastructure corridor development area. For each receptor, predicted concentrations of TSP, PM₁₀, PM_{2.5}, and NO₂ were assessed against the adopted ambient air quality criteria for all relevant averaging periods. As discussed in the preceding sections, all predicted concentrations at the identified sensitive receptors were below the adopted ambient air quality criteria.

Table 28 Compliance status of sensitive receptors identified for the infrastructure corridor area

Sensitive Receptor	TSP	PM ₁₀	PM _{2.5}	NO ₂
Adopted ambient air quality criteria	24-hour: 150 µg/m³; Annual: 75 µg/m³	24-hour: 45 µg/m³; Annual: 15 µg/m³	24-hour: 15 µg/m³; Annual: 5 µg/m³	1-hour: 188 µg/m³; Annual: 100 µg/m³
Finalbin	Complies	Complies	Complies	Complies
Bultem	Complies	Complies	Complies	Complies
Kavorabip	Complies	Complies	Complies	Complies
Kawentikin	Complies	Complies	Complies	Complies
Tabubil	Complies	Complies	Complies	Complies
Kumguit	Complies	Complies	Complies	Complies
Wangbin	Complies	Complies	Complies	Complies
Kumkit/Ankit	Complies	Complies	Complies	Complies
Ok Teditau	Complies	Complies	Complies	Complies
Niokskiwi/Ok Ma	Complies	Complies	Complies	Complies
Walawam	Complies	Complies	Complies	Complies
Kolebon	Complies	Complies	Complies	Complies
Wogam	Complies	Complies	Complies	Complies
Ningerum	Complies	Complies	Complies	Complies
Awin Tamaro	Complies	Complies	Complies	Complies
Hiorinkia	Complies	Complies	Complies	Complies
Karandimok	Complies	Complies	Complies	Complies
Alice Pit	Complies	Complies	Complies	Complies
Birmkamba	Complies	Complies	Complies	Complies

9.3 QUALITATIVE AIR QUALITY ASSESSMENT

9.3.1 Infrastructure Corridor – Construction Phase

Pipeline and access road construction activities were classified under the IAQM framework as Earthworks / Construction / Track-out Construction / Track-out, with a Medium dust emission magnitude. Receptor sensitivity is assessed as High, reflecting the presence of residential receptors and villages located in close proximity to sections of the construction corridor, including locations where receptors may occur within approximately 10 m of active works (refer Section 6).

Quantitative modelling confirms that infrastructure corridor construction results in the highest predicted short-term particulate matter concentrations among the assessed construction scenarios. The maximum predicted 24-hour concentrations of TSP (3.56 µg/m³) and PM₁₀ (1.57 µg/m³) occur under conservative near-field conditions and remain well below the adopted ambient air quality criteria of 150 µg/m³ and 45 µg/m³, respectively. Annual average PM₁₀ and PM_{2.5} concentrations are also low (0.11 µg/m³ and 0.02 µg/m³, respectively), remaining well below the adopted long-term ambient air quality criteria.

Quantitative modelling confirms that infrastructure corridor construction results in the highest predicted short-term particulate matter concentrations among the assessed construction scenarios. The maximum predicted 24-hour concentrations of TSP (3.56 µg/m³) and PM₁₀ (1.57 µg/m³) occur under conservative near-

field conditions and remain well below the adopted ambient air quality criteria of 150 µg/m³ and 45 µg/m³, respectively. Annual average PM₁₀ and PM_{2.5} concentrations are also low (0.11 µg/m³ and 0.02 µg/m³, respectively), remaining well below the adopted long-term ambient air quality criteria.

These results are based on a conservative modelling representation of the infrastructure corridor as a continuous line source, applied uniformly along the alignment. This approach assumes simultaneous activity along the corridor and therefore represents worst-case conditions for dispersion. As such, the predicted maximum concentrations are considered representative of upper-bound impacts along the entire infrastructure corridor, confirming that all sensitive receptors along the corridor would experience concentrations equal to or lower than these values and remain below the adopted ambient air quality criteria.

Consistent with IAQM Step 2C, the combination of Medium dust emission magnitude and High receptor sensitivity results in a High unmitigated dust risk, reflecting the potential for short-term amenity effects and localized PM₁₀ exposure at receptors closest to active works prior to the application of mitigation.

Following implementation of mitigation measures, residual dust impacts are expected to be reduced to Low–Medium in accordance with IAQM Step 4. This reflects the fact that predicted concentrations remain below the adopted ambient air quality criteria, that impacts are localized and temporary, and that exposure at any individual receptor is limited in duration as construction progresses along the corridor.

Key mitigation measures include:

- targeted dust suppression of active work areas and unsealed access routes during extended dry periods;
- traffic management controls, including speed restrictions and defined haul routes, to reduce dust entrainment from vehicle movement;
- management of material handling activities, including minimising drop heights during loading/unloading and avoiding unnecessary disturbance of exposed soils;
- control of material carry-over from construction areas onto access and public roads; and
- phased construction practices, which limit the spatial extent and duration of exposed surfaces, particularly in areas closest to sensitive receptors.

Collectively, these measures act to reduce both the generation of dust emissions at source and the potential for transport of particulate matter toward nearby receptors. As a result, residual impacts are expected to be localized, short-term, and manageable, consistent with a Low–Medium residual impact classification under the IAQM framework.

NO₂ modelling further supports this conclusion, with predicted 1-hour and annual average concentrations during infrastructure corridor construction remaining well below the adopted ambient air quality criteria and not contributing materially to construction-phase air quality impacts. Accordingly, particulate matter remains the dominant pollutant of interest for infrastructure corridor construction, but predicted impacts remain below the adopted criteria and are not expected to result in significant health effects at nearby communities.

9.3.2 Tailings Storage Facility – Construction Phase

Construction of the TSF was classified under the IAQM framework as Earthworks / Construction / Track-out, with a Large dust emission magnitude, reflecting the scale, intensity, and persistence of earthworks across a fixed footprint. Receptor sensitivity is assessed as High, with nearby communities located approximately 190 m from the TSF footprint.

Quantitative modelling indicates that, although TSF construction emissions are distributed across a large area source, particulate matter concentrations remain low in absolute terms. The maximum predicted 24-hour concentrations of TSP (0.69 µg/m³) and PM_{2.5} (0.67 µg/m³), and the predicted annual concentrations of TSP (1.33×10^{-4} µg/m³), PM₁₀ (3.93×10^{-5} µg/m³), and PM_{2.5} (7.04×10^{-6} µg/m³) are all well below the adopted ambient air quality criteria.

Consistent with IAQM Step 2C, the combination of Large dust emission magnitude and High receptor sensitivity results in a High unmitigated dust risk, reflecting the potential for localized, short-term amenity effects and elevated particulate concentrations in the immediate vicinity of active works prior to mitigation.

However, consistent with IAQM Step 4, the corresponding residual dust impacts are appropriately classified as Low–Medium, reflecting the fact that predicted concentrations remain below the adopted ambient air quality criteria, emissions are distributed across the footprint rather than concentrated at a single location, and exposure at any individual receptor is limited as construction progresses across the site.

Overall, dust impacts associated with TSF construction are expected to be localized, short-term, and manageable, with low annual average concentrations and no exceedance of the adopted ambient air quality criteria at sensitive receptors.

9.4 TAILINGS STORAGE FACILITY – OPERATIONAL PHASE

The IAQM qualitative framework is primarily intended to assess dust-generating construction activities and is therefore not directly applicable to TSF operations, where emissions are governed by a different mechanism.

Quantitative modelling demonstrates that particulate matter emissions during TSF operations are very low, with predicted PM₁₀ and PM_{2.5} concentrations significantly lower than those during construction and negligible relative to the adopted ambient air quality criteria. As such, dust does not represent a significant operational risk and is not carried forward into the IAQM qualitative assessment.

In contrast, operational modelling identifies NO₂ as the governing pollutant during TSF operations, driven by emissions from the on-site 11 MW diesel power generation system. The maximum predicted NO₂ concentrations are 112.3 µg/m³ (1-hour) and 5.05 µg/m³ (annual average), compared to adopted ambient air quality criteria of 188 µg/m³ and 100 µg/m³, respectively.

These maximum values are derived from the full receptor grid and represent the highest predicted concentrations anywhere within the modelling domain, providing a conservative upper bound on potential impacts. As such, concentrations at all identified sensitive receptors are equal to or lower than these values and remain below the adopted ambient air quality criteria.

While NO₂ concentrations reflect the semi-continuous nature of power generation, the results demonstrate that impacts remain low in absolute terms and well within the adopted ambient air quality criteria for both short-term and long-term averaging periods. Accordingly, NO₂ represents the primary pollutant of interest for the operational phase; however, it does not constitute a limiting factor for air quality impacts given the substantial margin of compliance with the adopted criteria.

9.5 DUST DEPOSITION

Based on worst-case modeled concentrations across the assessed scenarios, predicted dust deposition rates are estimated as follows:

- TSF construction: 1.82×10^{-1} g/m²/month
- Operations: 3.89×10^{-4} g/m²/month
- Infrastructure corridor construction (maximum): 9.35×10^{-1} g/m²/month

These predicted deposition rates are below the adopted assessment criteria, which include:

- 2 g/m²/month (incremental deposition), and
- 4 g/m²/month (total deposition).

It is noted that this approach provides a conservative, screening-level estimate and does not explicitly capture very near-field mechanical deposition processes (such as track-out or immediate coarse particle settling

adjacent to active work areas). However, given the substantial margin between predicted deposition rates and the adopted criteria, the assessment supports the conclusion that dust deposition impacts associated with the Project are below the adopted criteria.

9.6 OVERALL AIR QUALITY ASSESSMENT STATEMENT

In summary, the IAQM qualitative dust risk assessment and the quantitative air dispersion modelling are aligned as follows:

- Infrastructure corridor construction is associated with the highest predicted short-term particulate matter concentrations under conservative near-field assumptions. Consistent with the combination of Medium dust emission magnitude and High receptor sensitivity, this results in a High unmitigated dust risk, which is reduced to a Low–Medium residual impact following the implementation of mitigation measures. Predicted concentrations remain below the adopted ambient air quality criteria across the modelling domain.
- TSF construction is characterized by a Large dust emission magnitude due to the scale and duration of earthworks, but results in lower modelled concentrations due to the distributed nature of emissions across a large area. Consistent with IAQM Step 2C, this combination results in a High unmitigated dust risk, which is reduced to a Low–Medium residual impact following mitigation. Predicted concentrations remain below the adopted ambient air quality criteria, and impacts are localized and temporary.
- TSF operations are not governed by fugitive dust emissions, which are negligible in terms of contribution to ambient particulate matter concentrations. Instead, operational air quality impacts are governed by NO_x emissions from the on-site 11 MW diesel power generation system, assessed quantitatively as NO₂. Dispersion modelling demonstrates that predicted NO₂ concentrations remain below the adopted ambient air quality criteria for both short-term and long-term averaging periods, and are not expected to result in significant impacts at nearby receptors.

Overall, this integrated assessment provides a clear, conservative, and technically robust basis for evaluating air quality impacts across all project phases, demonstrating that predicted impacts remain below the adopted ambient air quality criteria and are localized, temporary, and manageable with the implementation of appropriate mitigation measures.

10. GREENHOUSE GAS ASSESSMENT

10.1 RELEVANT GHG LEGISLATION, GUIDELINES, AND POLICIES

Greenhouse gas (GHG) emissions associated with the Project have been assessed in the context of applicable international frameworks and guidance, consistent with the requirements for environmental and social impact assessment of large-scale resource development projects.

In Papua New Guinea (PNG), there are currently no project-specific statutory limits for GHG emissions under the Environment Act 2000. However, environmental assessment and management of emissions are guided through broader environmental approval processes administered by the Conservation and Environment Protection Authority (CEPA), which require the identification and evaluation of potential environmental impacts, including climate-related considerations.

Applicable internationally recognised standards and guidelines considered in this assessment include:

- International Finance Corporation (IFC) Environmental, Health, and Safety (EHS) Guidelines, which require that projects:
 - Quantify and report GHG emissions where material, and

- Implement cost-effective measures to reduce emissions consistent with good international industry practice.
- Greenhouse Gas Protocol (GHG Protocol), which provides the globally accepted framework for:
 - Classification of emissions into Scope 1, Scope 2, and Scope 3 categories, and
 - Consistent accounting and reporting of project-related emissions.
- Australian National Greenhouse Accounts (NGA) Factors (2025), which provide:
 - Standard emission factors for fuel combustion and transport activities, and
 - A recognised methodology for quantifying Scope 1 emissions in the absence of project-specific emission factors.
- Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (2006), which inform:
 - Estimation of emissions from vegetation clearing and land-use change, and
 - Calculation of carbon stock loss associated with project disturbance.

In addition, the assessment takes into account PNG's international commitments under the Paris Agreement, including the country's Nationally Determined Contribution (NDC), which establishes national targets for reducing greenhouse gas emissions and enhancing carbon sinks.

Consistent with these frameworks, the Project's GHG emissions have been quantified using an activity-based methodology and evaluated within the context of international good practice.

10.2 QUANTITATIVE GHG ASSESSMENT

A quantitative GHG assessment has been performed for the project. The assessment was performed using the following processes:

- Definition of the project activities
- Identification of emission sources from project activities
- Identification of activity data for each emission source
- Identification of emission calculation methodologies for each source
- Calculation of GHG emissions

This assessment follows the Australian Government Department of Climate Change, Energy, the Environment and Water Australian National Greenhouse Accounts Factors for Individuals and Organisations Estimating GHG Emissions (2025) in categorizing direct and indirect emissions into scopes as follows:

- Scope 1: All direct GHG emissions produced from sources within the boundary of an organisation and as a result of that organisation's activities.
- Scope 2: Indirect emissions associated with the consumption of purchased electricity and other externally generated utilities.
- Scope 3: All other indirect emissions not included in Scope 2 (electricity), which occur outside the boundary or control of an organisation.

This assessment considers Scope 1 emissions only, representing direct greenhouse gas emissions from project-controlled sources.

Scope 1 emissions are calculated below.

10.2.1 Calculation of GHG Emissions from Vegetation Clearing

Greenhouse gas (GHG) emissions associated with vegetation clearing were estimated using a methodology aligned with Papua New Guinea's Second National REDD+ Forest Reference Level (FREL), which provides country-specific emission factors for relevant forest types. In accordance with Table 6-4 (refer also Table 11-1), the Project area is characterized as Primary low-altitude forest on plains and fans, with an emission factor of 526.5 tCO₂/ha.

Applying this factor to the estimated clearing area of approximately 1,900 ha results in total GHG emissions of approximately 1,000,350 tCO₂e associated with vegetation clearing. When considered over an extended project timeframe of approximately 23 years, reflecting the staged nature of vegetation clearing, including activities occurring during Years 10 to 12, this corresponds to an average emission of approximately 43,493 tCO₂e/year. This approach reflects country-specific carbon stock assumptions and national greenhouse gas accounting practices, and is therefore considered the most representative estimate for the Project.

In parallel, a secondary estimate was developed using the UNFCCC A/R methodological tool (Version 03) in conjunction with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4: Agriculture, Forestry, and Other Land Use), consistent with project-level carbon stock estimation approaches. Cleared vegetation was assumed to be chipped and mulched for rehabilitation purposes and/or stockpiled to naturally decay, with some material potentially salvaged for local use.

Emissions associated with vegetation clearing were estimated using Equations 1 to 3 of the UNFCCC A/R methodological tool, which quantify carbon stock loss and subsequent emissions from biomass decay. Application of this methodology results in a total emission estimate of approximately 3,307,111.50 tCO₂e associated with vegetation clearing.

The difference between the two estimates reflects variation in methodological assumptions, including the use of country-specific versus default emission factors, as well as differences in biomass stock representation and decay processes. The PNG FREL-based estimate is considered the most representative of national carbon accounting practices, while the UNFCCC/IPCC-based estimate provides a conservative upper bound for project-level emissions.

Accordingly, the assessment adopts the PNG FREL-based estimate as the primary value, while recognizing the UNFCCC/IPCC-based estimate as a conservative upper bound for impact evaluation.

10.2.2 Direct Emissions

The direct emission sources considered in this GHG assessment are the same emission sources considered in the air quality assessment. See tables below for specific sources.

10.2.3 Global Warming Potential

The global warming potential is a measure of a GHG global warming effect relative to an amount of CO₂ over a certain period of time. Global warming potentials are used to convert amounts of different greenhouse gases into its carbon dioxide equivalent (CO₂-e). This assessment presents the estimated GHG emissions from combustion sources in terms of their carbon dioxide equivalent (t CO₂e). The global warming potentials of relevance to this assessment, as taken from Australia's National Greenhouse Accounts Factors (2025), are presented in Table 29

Table 29 Global Warming Potentials

Gas	Global Warming Potential (AR5)
Carbon Dioxide (CO ₂)	1

Gas	Global Warming Potential (AR5)
Methane (CH4)	28
Nitrous Oxide (N2O)	265

10.2.4 Calculation of GHG Emissions from the Project

GHG emissions were calculated using emission factors, energy content factors, and formulas from the Australian Government's National Greenhouse Accounts Factors (Australian Department of the Environment, Water, Heritage, and the Arts 2025). Table 8 (Stationary Combustion of Liquid Fuels - Diesel Oil) and Table 9 (Transport Fuel Emissions - Heavy duty vehicles: Diesel oil) were primarily used to derive appropriate emission and energy content factors for the necessary equipment to be used for construction and operations throughout the year. Emission factors allow the quantity of GHG emitted by a source to be calculated from defined units of activity. Estimated yearly fuel consumption for the construction and operation equipment of each activity was used as the input value to calculate the projected emissions for the year per the amount of fuel consumed. Each combustion source's fuel consumption was measured in litres of diesel per year. The Australian Government's National Greenhouse Accounts Factors (2025) lists different CH4 emission factor values for multiple diesel types (Euro i, iii, and iv or higher). Since the diesel type for the construction and operation equipment was not specified in the provided data, the average of the multiple diesel types was used for CH4 emission factors.

Tables 30 to 32 show the results of each activity's (infrastructure corridor construction, TSF construction, and project operations) combustion sources estimated Scope 1 GHG emissions in tons of CO2 equivalent for various greenhouse gases per year.

Table 30 Infrastructure Corridor Construction – Mobile and Stationary Source Combustion Scope 1 GHG Emissions

Combustion Sources	t CO2e/GJ CO2	t CO2e/GJ CH4	t CO2e/GJ N2O	Combined t CO2e
Crew Bus (22-seater) (3 units)	589	1.00	3.37	594
Supt Vehicle (3 units)	786	1.40	4.50	792
Excavator (45t) (6 units)	4,714	8.30	26.98	4,750
Dump Truck (10 units)	5,893	10.40	33.72	5,937
Dozer (D8) (4 units)	1,571	2.80	8.99	1,583
Service Trucks (1 unit)	589	1.00	3.37	594
Fuel Truck (1 unit)	589	1.00	3.37	594
Pipe Loaders (3 units)	589	1.00	3.37	594
Cranes (Franna) (3 units)	589	1.00	3.37	594
Floater (1 unit)	196	0.30	1.12	198

Combustion Sources	t CO2e/GJ CO2	t CO2e/GJ CH4	t CO2e/GJ N2O	Combined t CO2e
Genset 1250 kVA 415V (1)	589	0.80	1.69	592
Convoy Trucks (6 units)	786	1.40	4.50	792
Totals	17,482	30.60	98.35	17,611

Table 31 TSF Construction – Mobile and Stationary Source Combustion Scope 1 GHG Emissions

Combustion Sources	t CO2e/GJ CO2	t CO2e/GJ CH4	t CO2e/GJ N2O	Combined t CO2e
Crew Bus (57-seater) (3 units)	589	1	3.37	594
Supt Vehicle (3 units)	786	1.4	4.5	792
Excavator (30t) (6 units)	2357	4.2	13.49	2375
Trucks (45 tonne Moxies) (6 units)	3536	6.2	20.23	3562
Dozer (D8) (4 units)	1179	2.1	6.74	1187
Service Trucks (1 unit)	589	1	3.37	594
Fuel Truck (1 unit)	589	1	3.37	594
Grader (2)	393	0.7	2.25	396
Mobile Crushing Plant (2 units)	393	0.7	2.25	396
Wheel Loader (3 units)	589	1	3.37	594
IT Loader (3 units)	589	1	3.37	594
Genset (50kva) (3 units)	589	0.8	1.69	592
Convoy Trucks (6)	786	1.4	4.5	792
Totals	12,964	23	73	13,059

Table 32 Project Operations – Mobile and Stationary Source Combustion Scope 1 GHG Emissions

Combustion Sources	t CO2e/GJ CO2	t CO2e/GJ CH4	t CO2e/GJ N2O	Combined t CO2e
Excavator (4 units)	3,143	5.53	17.98	3,166

Combustion Sources	t CO ₂ e/GJ CO ₂	t CO ₂ e/GJ CH ₄	t CO ₂ e/GJ N ₂ O	Combined t CO ₂ e
Dozer (4 units)	1,571	2.77	8.99	1,583
Diesel Generator (Genset 50kVA) (3 units)	589	0.84	1.69	592
Gensets (11 MW installed capacity)	30,219	43.23	86.46	30,349
Bus (3 units)	589	1.04	3.37	594
Dump Trucks (10 units)	5,893	10.37	33.72	5,937
Supt Vehicle (9 units)	1,768	3.11	10.12	1,781
Convoy Trucks (6 units)	786	1.38	4.5	792
Totals	44,558	68	167	44,793

The total estimated Scope 1 greenhouse gas (GHG) emissions associated with the Project are approximately 1,031,020 tCO₂e, comprised of 30,670 tCO₂e from construction activities (including 17,611 tCO₂e from infrastructure construction and 13,059 tCO₂e from TSF construction), 44,793 tCO₂e/year during operations, and 1,000,350 tCO₂e associated with vegetation clearing. Vegetation clearance represents the dominant source of Project-related GHG emissions.

While these emissions represent a one-time release of stored carbon, they will occur in a staged manner over both construction and operational phases in line with the progressive development of the TSF. This includes vegetation clearing associated with later-stage activities (e.g., approximately 500 ha during the operational phase for Cell 2 development).

During the construction phase, combustion-related emissions are comparatively minor relative to vegetation clearing and are primarily driven by mobile equipment and diesel-powered plant. The largest contributors to combustion emissions are heavy-duty haulage and earthmoving equipment, with dump trucks and excavators collectively representing a substantial proportion of total construction emissions. These emission sources reflect the intensity of material movement and earthworks required for both the infrastructure corridor and TSF construction works.

During the operational phase, total Scope 1 emissions are dominated by diesel combustion associated with on-site power generation. The 11 MW diesel generator accounts for approximately 68% of total operational emissions, equivalent to approximately 30,349 tCO₂e/year, with the remaining emissions primarily attributable to mobile equipment such as haul trucks, and mobile plant operations such as dozers and excavators. This concentration of emissions in a single source category is typical of remote mining operations reliant on diesel-based power systems.

From a temporal perspective, the majority of Project GHG emissions occur during the initial construction phase as a result of vegetation clearing, which represents a one-time emission event. In contrast, operational emissions are ongoing but comparatively smaller on an annual basis.

In the context of Papua New Guinea's national greenhouse gas inventory, the Project's annual operational emissions (44,793 tCO₂e/year) represent a small fraction of national emissions, and are not expected to materially influence PNG's national emissions trajectory or commitments under the Paris Agreement.

However, the contribution from vegetation clearing reflects the broader trend of land-use changes in national emissions profiles and highlights the value of minimising disturbance where practicable.

Overall, the Project's GHG emissions profile is consistent with comparable large-scale developments including Bige operations, characterised by:

- A dominant one-time land clearing emission component, and
- Operational emissions primarily driven by diesel combustion for power generation and mobile equipment.

In the absence of regulatory GHG emission limits, the assessment demonstrates that emissions have been quantified using internationally recognised methodologies and are consistent with good international industry practice.

11. SUMMARY AND OVERALL ASSESSMENT STATEMENT

This section provides a summary of the air quality and GHG assessment findings for the project. It presents the key results of the quantitative dispersion modelling, qualitative construction dust risk assessment, and GHG inventory, identifies the governing pollutants by project phase, and presents the overall conclusions regarding the significance and acceptability of potential impacts.

The assessment demonstrates that air quality impacts vary markedly across project phases and components, reflecting differences in source type, spatial extent, duration, and proximity to sensitive receptors. The applied assessment methods are complementary and provide a robust, defensible basis for characterising both short-term construction impacts and long-term operational emissions.

11.1 CONSTRUCTION PHASE – INFRASTRUCTURE CORRIDOR

Pipeline and access road construction represents the most acute short-term dust impact scenario, driven by linear works undertaken in close proximity to residential villages and community receptors.

- **Particulate Matter (TSP and PM₁₀):** Quantitative modelling indicates the highest short-term predicted particulate concentrations occur during infrastructure corridor construction, reflecting limited dispersion due to receptor proximity and near-field source geometry. The IAQM qualitative assessment classifies pipeline construction as having a High unmitigated dust risk, primarily associated with dust soiling (amenity) and short-term PM₁₀ health impacts.
- **Residual Risk with Mitigation:** With implementation of enhanced, site-specific mitigation measures, including continuous dust suppression, strict traffic and track-out controls, and phased construction through populated areas, residual dust impacts are expected to be Low to Medium. Impacts are assessed as temporary, localized, and manageable, and not significant provided controls are implemented and monitored.
- **NO_x Emissions:** Combustion-related NO_x emissions from infrastructure corridor construction are negligible. Modeled 1-hour and annual NO_x concentrations are orders of magnitude below relevant health-based criteria and do not contribute materially to air quality impact significance during construction.

11.2 CONSTRUCTION PHASE - TAILINGS STORAGE FACILITY

TSF construction involves extensive earthworks within the proposed development area over a three-year construction period. While predicted ground-level concentrations are lower than for the infrastructure corridor construction, the scale and duration of activities elevate qualitative risk as follows:

- **Particulate Matter:** Quantitative modelling indicates measurable but low absolute particulate concentrations at off-site receptors. However, under the IAQM framework, TSF construction is classified as having a Large dust emission magnitude and High receptor sensitivity, resulting in a High unmitigated dust risk.
- **Residual Risk with Mitigation:** With comprehensive and sustained mitigation measures, including dust suppression during dry periods, surface stabilization, haul road management, and operational controls during adverse conditions, residual dust impacts are assessed as Low to Medium. Residual impacts are expected to be intermittent, temporary, and reversible, and not significant provided mitigation is effectively applied.
- **NO_x Emissions:** Combustion emissions during TSF construction are minor. Modeled NO_x concentrations are negligible and clearly subordinate to particulate matter emissions, and therefore do not influence construction-phase impact significance.

11.3 OPERATIONAL PHASE

The operational phase is characterized by markedly different emission dynamics from construction and represents the primary long-term air quality consideration for the project.

- **Particulate Matter:** Fugitive dust emissions from TSF operations are low and episodic. Quantitative modelling demonstrates that PM₁₀ and PM_{2.5} concentrations during operations are an order of magnitude lower than construction-phase impacts and well below applicable ambient air quality criteria. Dust does not represent a significant operational risk and is not governed by the IAQM dust framework.
- **NO_x Emissions:** Continuous operation of on-site diesel generators results in sustained NO_x emissions, which are assessed as NO₂ for comparison with the adopted ambient air quality criteria. Dispersion modelling indicates that the maximum predicted NO₂ concentrations are 112.3 µg/m³ (1-hour) and 5.05 µg/m³ (annual average), both of which remain well below the adopted ambient air quality criteria for short-term and long-term exposure. While NO₂ represents the governing pollutant during the operational phase due to the continuous nature of power generation, the predicted concentrations are low in absolute terms and do not result in exceedances at any location within the modelling domain, including at sensitive receptors. As such, operational NO₂ emissions, while persistent, are not expected to result in significant air quality or human health impacts.

11.4 GREENHOUSE GAS ASSESSMENT – SUMMARY

The GHG assessment indicates that project-related Scope 1 emissions are dominated by:

- Land clearing, which represents a substantial release of stored carbon associated with vegetation removal, estimated at approximately 1,000,350 tCO₂e (occurring as a staged, one-time release over the life of the Project); and
- Diesel fuel combustion, particularly from stationary generators during the operational phase, which represents the largest ongoing source of GHG emissions at approximately 44,793 tCO₂e/year

Additional emissions associated with construction activities are comparatively minor, totaling approximately 30,670 tCO₂e, equivalent to approximately 10,200 tCO₂e/year when averaged over a three-year construction period.

Based on these estimates, total annual GHG emissions during the operational phase are approximately 44,793 tCO₂e/year, which exceed annual construction emissions due to the continuous nature of power generation. The total Scope 1 GHG emissions associated with the Project are estimated at approximately 1,031,020 tCO₂e, dominated by vegetation clearing.

In the context of Papua New Guinea's national greenhouse gas inventory, project-related annual emissions represent approximately 1% of Papua New Guinea's annual GHG emissions, which are on the order of several thousand kilotonnes CO₂e per year. As such, the Project is not expected to materially influence national emissions trends or compromise Papua New Guinea's climate commitments.

Overall, while GHG emissions are substantial in absolute terms due to the scale of vegetation clearing, they are consistent with the nature and scale of a long-life mining infrastructure project and have been quantified using internationally recognized and country-specific methodologies.

The table below summarises the total and annual Scope 1 GHG emissions associated with the Project, including the relative contribution of key emission sources on an annual basis.

Table 33 Summary of Project Scope 1 GHG Emissions (with % Contribution)

Emission Source	Total Emissions (tCO ₂ e)	Annual Emissions (tCO ₂ e/year)	% of Total Annual Emissions	Notes
Vegetation Clearing	1,000,350	~43,493*	49%	One-time release, staged over project life (including ~500 ha during operations)
Construction – TSF	13,059	~4,353	5%	Based on 3-year construction period
Construction – Infrastructure Corridor	17,611	~5,870	7%	Based on 3-year construction period
Total Construction	30,670	~10,223	12%	Minor contributor relative to operations and clearing
Operations (Diesel Combustion)	—	44,793	50%	11 MW on-site power generation
Total Annual Emissions	—	~88,509	100%	Includes clearing (annualized), construction, and operations

Annual GHG emissions are primarily driven by operational diesel combustion (approximately 50%) and staged vegetation clearing (approximately 49%), with construction activities contributing a comparatively small proportion (approximately 12%). This reflects the distinction between ongoing operational emissions and the staged release of carbon from land disturbance over the life of the Project

11.5 OVERALL ASSESSMENT

Based on quantitative modelling, qualitative risk assessment, and GHG analysis, the following overall conclusions are drawn:

- Construction-phase air quality impacts are dominated by fugitive dust emissions. Unmitigated risks are assessed as High where receptors are in close proximity; however, with appropriate mitigation, residual impacts are Low to Medium, localized, temporary, and manageable, and are not considered significant.
- Operational air quality impacts are associated with continuous NO_x emissions from on-site diesel power generation (assessed as NO₂). While NO₂ represents the primary operational pollutant, dispersion modelling demonstrates that predicted concentrations remain well below the adopted

ambient air quality criteria for both short-term and long-term averaging periods, and are not expected to result in significant impacts at nearby receptors.

- GHG emissions are driven primarily by staged vegetation clearance and diesel combustion for on-site power generation during operations. While vegetation clearing represents a one-time release of stored carbon, it occurs progressively over the life of the Project. Emissions have been robustly quantified using both country-specific and internationally recognized methodologies and are consistent with comparable large-scale developments.

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APPENDIX A: ASSUMPTIONS, EMISSION FACTORS, AND CRITERIA POLLUTANT AND GHG INVENTORIES

Criteria Pollutant Inventories GHG Assumptions

	Parameter	Assumption/Value/Categorization	Unit/yr	Assumption/Basis/Source
Combustion Criteria Pollutant Emission Factors	General Combustion Criteria Pollutant Source	Australian National Pollutant Inventory (NPI) Emission Estimation Technique Manual (EETM) for Combustion Engines (Version 3.0, 2008)		
	TSP	PM10 Emission Factor	kg/litre	As the NPI EETM Combustion Version 3.0 2008 does not list any emission factors for TS, based off judgement, it was assumed that emission factors for TSP are equivalent to PM10's emission factors.
	Transport Buses (22 seater) - Combustion Emission Factor	Converted original manual listed value (listed in kg/m ³) divided by 1000, for all criteria pollutants	kg/litre	HGV, Table 23
	Supt Vehicle - Combustion Emission Factor	Converted original manual listed value (listed in kg/kWh) multiplied by 3.3, for all criteria pollutants	kg/litre	Diesel industrial vehicle (miscellaneous) exhaust emissions, Table 35
	Excavator - Combustion Emission Factor	Converted original manual listed value (listed in kg/kWh) multiplied by 3.3, for all criteria pollutants	kg/litre	Track-type tractor, Table 26
	Dump Truck - Combustion Emission Factor	Converted original manual listed value (listed in kg/m ³) divided by 1000, for all criteria pollutants	kg/litre	HGV, Table 21
	Dozer (D8) - Combustion Emission Factor	Converted original manual listed value (listed in kg/kWh) multiplied by 3.3, for all criteria pollutants	kg/litre	Track-type tractor, Table 26
	Service Trucks - Combustion Emission Factor	Converted original manual listed value (listed in kg/m ³) divided by 1000, for all criteria pollutants	kg/litre	Emission factors (kg/m ³) for diesel vehicle exhaust emissions (LGV), Table 15
	Fuel Truck - Combustion Emission Factor	Converted original manual listed value (listed in kg/m ³) divided by 1000, for all criteria pollutants	kg/litre	Diesel vehicle exhaust emissions (HGV), Table 21
	Pipe Loaders - Combustion Emission Factor	Converted original manual listed value (listed in kg/kWh) multiplied by 3.3, for all criteria pollutants	kg/litre	Emission factors (kg/kWh) for diesel industrial vehicle (wheeled loader) exhaust emissions, Table 31
	Cranes (Franna) - Combustion Emission Factor	Converted original manual listed value (listed in kg/kWh) multiplied by 3.3, for all criteria pollutants	kg/litre	Emission factors (kg/kWh) for diesel industrial vehicle (wheeled loader) exhaust emissions, Table 31
	Floater - Combustion Emission Factor	Converted original manual listed value (listed in kg/m ³) divided by 1000, for all criteria pollutants	kg/litre	Emission factors (kg/m ³) for stationary large (greater than 450 kW) diesel engines, Table 43
	Gensets (kva) - Combustion Emission Factor	Converted original manual listed value (listed in kg/m ³) divided by 1000, for all criteria pollutants	kg/litre	Engines less than 450kW, Table 50
	Convoy Trucks - Combustion Emission Factor	Converted original manual listed value (listed in kg/m ³) divided by 1000, for all criteria pollutants	kg/litre	Diesel vehicle exhaust emissions (HGV), Table 21

Criteria Pollutant Inventories GHG Assumptions

⌚	Parameter	Assumption/Value/Categorization	Unit/yr	Assumption/Basis/Source
	Trucks (45 tonne Moxies) - Combustion Emission Factor	Converted original manual listed value (listed in kg/kWh) multiplied by 3.3, for all criteria pollutants	kg/litre	Emission factors (kg/kWh) for diesel industrial vehicle (off-highway truck) exhaust emissions, Table 33
	Grader - Combustion Emission Factor	Converted original manual listed value (listed in kg/kWh) multiplied by 3.3, for all criteria pollutants	kg/litre	Motor grader, Table 30
	Mobile Crushing Plant - Combustion Emission Factor	Converted original manual listed value (listed in kg/kWh) multiplied by 3.3, for all criteria pollutants	kg/litre	Emission factors (kg/kWh) for diesel industrial vehicle (scraper) exhaust emissions, Table 29
	Wheel Loader - Combustion Emission Factor	Converted original manual listed value (listed in kg/kWh) multiplied by 3.3, for all criteria pollutants	kg/litre	Emission factors (kg/kWh) for diesel industrial vehicle (wheeled loader) exhaust emissions, Table 31
	IT Loader - Combustion Emission Factor	Converted original manual listed value (listed in kg/kWh) multiplied by 3.3, for all criteria pollutants	kg/litre	Emission factors (kg/kWh) for diesel industrial vehicle (wheeled loader) exhaust emissions, Table 31
	Gensets (11 MW installed capacity) - Combustion Emission Factor	Converted original manual listed value (listed in kg/m ³) divided by 1000, for all criteria pollutants	kg/litre	Engines greater than 450kW, Table 43
Factors	General Dust Generation Criteria Pollutant Source	Australian National Pollutant Inventory (NPI) Emission Estimation Technique Manual (EETM) for Mining (Version 3.1, 2012),		
	Emission Factors - PM2.5	PM10(EF)*0.1	Differs respective to each source and pollutant	As the NPI EETM Mining Version 3.1 2012 does not list any emission factors for PM2.5, based off judgement, it was assumed that emission factors for PM2.5 are equivalent to 10% of PM10's emission factors.
	Transport Buses (22 seater)	Site Personnel Travel Unpaved Roads	kg/Vehicle Kilometers Traveled (VKT)	NPI M- Wheel generated dust from unpaved roads at industrial sites, Table 2 default emission factors
	Supt Vehicle - Dust Generation Emission Factor	Unpaved roads at development sites	Vehicle Kilometers Traveled (VKT)	Wheel generated dust from unpaved roads, Table 2 default emission factors
	Excavator - Dust Generation Emission Factor	Excavating	Tonnes	Excavators/Shovels/Front-end loaders (on overburden), Table 2 default emission factors
	Dump Truck - Dust Generation Emission Factor	Truck Unloading (dumping)	Tonnes	Trucks (dumping overburden), Table 2 default emission factors

Criteria Pollutant Inventories GHG Assumptions

	Parameter	Assumption/Value/Categorization	Unit/yr	Assumption/Basis/Source
Dust Generation Criteria Pollutant Emission	Dozer (D8) - Dust Generation Emission Factor	Bulldozing	vehicle-hrs	Bulldozer on material other than coal, Table 2 default emission factors
	Service Trucks - Dust Generation Emission Factor	Unpaved roads used by light duty vehicles	Vehicle Kilometers Traveled (VKT)	Wheel generated dust from unpaved roads (used by light duty vehicles), Table 2 default emission factors
	Fuel Truck - Dust Generation Emission Factor	Unpaved roads at development sites	Vehicle Kilometers Traveled (VKT)	Wheel generated dust from unpaved roads, Table 2 default emission factors
	Pipe Loaders - Dust Generation Emission Factor	Unpaved roads at development sites	Vehicle Kilometers Traveled (VKT)	Wheel generated dust from unpaved roads, Table 2 default emission factors
	Cranes (Franna) - Dust Generation Emission Factor	Unpaved roads at development sites	Vehicle Kilometers Traveled (VKT)	Wheel generated dust from unpaved roads, Table 2 default emission factors
	Convoy Trucks - Dust Generation Emission Factor	Miscellaneous transfer points	Tonnes	Miscellaneous transfer points, Table 2 default emission factors
	Trucks (45 tonne Moxies) - Dust Generation Emission Factor	Unpaved roads at development sites	Vehicle Kilometers Traveled (VKT)	Wheel generated dust from unpaved roads, Table 2 default emission factors
	Grader - Dust Generation Emission Factor	Graders	Vehicle Kilometers Traveled (VKT)	Graders, Table 2 default emission factors
	Mobile Crushing Plant - Dust Generation Emission Factor	Unpaved roads at development sites	Vehicle Kilometers Traveled (VKT)	Wheel generated dust from unpaved roads, Table 2 default emission factors
	Wheel Loader - Dust Generation Emission Factor	Unpaved roads at development sites	Vehicle Kilometers Traveled (VKT)	Wheel generated dust from unpaved roads, Table 2 default emission factors
	IT Loader - Dust Generation Emission Factor	Unpaved roads at development sites	Vehicle Kilometers Traveled (VKT)	Wheel generated dust from unpaved roads, Table 2 default emission factors

Criteria Pollutant Inventories GHG Assumptions

	Parameter	Assumption/Value/Categorization	Unit/yr	Assumption/Basis/Source
Corridor Combustion Criteria Pollutants and Greenhouse Gases	Daily Operational Time	12	hours/day	OTML Traffic assumptions lists that the haul trucks will be operating 10-12 hours/day during the construction phase. As no other mention of daily operational hours during the construction phase has been found in the project documentation, the conservative of the two values is being utilized. OTML Traffic assumptions found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Emission Factors	Differs respective to each source and pollutant	Differs respective to each source	Tables listed on NPI's EETM Combustion Engines Version 3.0 June 2008 and Australian National Greenhouse Accounts Factors (2025)
	Bus - Fuel Usage	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Supt Vehicle - Fuel Usage	291,200	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Excavator - Fuel Usage	1,747,200	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Dump Trucks - Fuel Usage	2,184,000	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Dozer - Fuel Usage	582,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Service Trucks - Fuel Usage	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Fuel Truck - Fuel Usage	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1

Criteria Pollutant Inventories GHG Assumptions

	Parameter	Assumption/Value/Categorization	Unit/yr	Assumption/Basis/Source
Infrastructure	Pipe loaders - Fuel Usage	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Cranes (Franna) - Fuel Usage	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Floater - Fuel Usage	72,800	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Gensets (kva) - Fuel Usage	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Convoy Trucks - Fuel Usage	291,200	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
Pollutants	Daily Operational Time	12	hours/day	OTML Traffic assumptions lists that the haul trucks will be operating 10-12 hours/day during the construction phase. As no other mention of daily operational hours during the construction phase has been found in the project documentation, the conservative of the two values is being utilized. OTML Traffic assumptions found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Emission Factors	Differs respective to each source and pollutant	Differs respective to each source and pollutant	Table 2 - NPI's EETM Mining Version 3.1 January 2012
	Bulldozing - Input Value	4,368	vehicle-hrs	Based off the assumption of 12 hours/day and 7 days/week work schedule. based off of traffic and fuel usage estimates provided on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1

Criteria Pollutant Inventories GHG Assumptions

	Parameter	Assumption/Value/Categorization	Unit/yr	Assumption/Basis/Source
Infrastructure Corridor Dust Generation Criteria Pollutants	Excavating - Input Value	403,844	Tonnes	The pipeline trench's depth and width are assumed to measure 1.829 m and the length is the 80% of the total pipeline (87 km) which is specified to be buried. The density of the ground was based on previous documentation listing the ground to be dense soil or bedrock (with the documentation listing a bedrock density of 17 kN/m ³ = 1.734 Tonnes/m ³).
	Miscellaneous transfer points - Input Value	47,944	Tonnes	An outer-diameter of 28 in = 0.7112 m was assumed based off research of the chosen pipe. This was utilized to determine how much material would need to be removed from the pipeline construction work site.
	Truck Unloading (dumping) - Input Value	403,844	Tonnes	Assumed to be equivalent to the excavation weight.
	Unpaved roads at development sites - Input Value	87	Vehicle Kilometers Traveled (VKT)	Large industrial vehicles were assumed to include the sup vehicles (4), fuel truck (1), pipe loaders (3), and the cranes (3). Assumed to not be utilized outside of the worksite, as a result, the annual distance traveled is assumed to equal the total pipeline length.
	Unpaved roads used by light duty vehicles - Input Value	63,336	Vehicle Kilometers Traveled (VKT)	Assumed to consider one listed service truck. Assumed to be heavily utilized; assumed to travel a distance equal to double the pipeline/access road length per week.
	Wind Erosion - Input Value	2,890,800	ha-hrs	Assumed to be affected 8,760 hours/year.

Criteria Pollutant Inventories GHG Assumptions

	Parameter	Assumption/Value/Categorization	Unit/yr	Assumption/Basis/Source
	Site Personnel Travel Unpaved Roads first half and second half - Input Value	21,840	Vehicle Kilometers Traveled (VKT)	Based off approx. distance traveled per 1-way trip on the provided traffic calcs, multiplied by 42 as the traffic calcs estimate 42 one-way trips per week, and multiplied by 52 to account for the annual amount. Although two separate camps will be utilized in the 1st and 2nd half of the construction phase, it appears the distances will remain very much the same; as a result, both are accounted for.
Criteria Pollutants and Greenhouse Gases	Daily Operational Time	12	hours/day	OTML Traffic assumptions lists that the haul trucks will be operating 10-12 hours/day during the construction phase. As no other mention of daily operational hours during the construction phase has been found in the project documentation, the conservative of the two values is being utilized. OTML Traffic assumptions found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Transport Buses (22 seater) - fuel consumption	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Supt Vehicle - fuel consumption	291,200	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Excavator (45t) - fuel consumption	873,600	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Trucks (45 tonne Moxies) - fuel consumption	1,310,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Dozer (D8) - fuel consumption	436,800	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1

Criteria Pollutant Inventories GHG Assumptions

	Parameter	Assumption/Value/Categorization	Unit/yr	Assumption/Basis/Source
TSF Development Area Combustion Criteria Pollutants	Service Trucks - fuel consumption	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Fuel Truck - fuel consumption	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Grader - fuel consumption	145,600	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Mobile Crushing Plant - fuel consumption	145,600	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Wheel Loader - fuel consumption	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	IT Loader - fuel consumption	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Genset (50kva) - fuel consumption	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Convoy Trucks - fuel consumption	291,200	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
Criteria Pollutants	Daily Operational Time	12	hours/day	OTML Traffic assumptions lists that the haul trucks will be operating 10-12 hours/day during the construction phase. As no other mention of daily operational hours during the construction phase has been found in the project documentation, the conservative of the two values is being utilized. OTML Traffic assumptions found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1

Criteria Pollutant Inventories GHG Assumptions

	Parameter	Assumption/Value/Categorization	Unit/yr	Assumption/Basis/Source
TSF Development Area Dust Generation Criteria Pollu	Bulldozing - Input Value	4,368	vehicle-hrs	Based off the assumption of 12 hours/day and 7 days/week work schedule. based off of traffic and fuel usage estimates provided on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Excavating - Input Value	69,500,000	Tonnes	Assumed to = total TSF capacity/3 (3 years of construction)
	Graders - Input Value	1,113	Vehicle Kilometers Traveled (VKT)	Assumed to travel a total distance equal to the perimeter of the TSF site per year.
	Miscellaneous transfers - Input Value	69,500,000	Tonnes	Assumed to = total TSF capacity/3 (3 years of construction)
	Unpaved roads at development sites - Input Value	189,028	Vehicle Kilometers Traveled (VKT)	Assumed to include mobile wheel loader, It loader crushing plants, supt vehicle, fuel trucks, and Trucks (45 tonne Moxies). Hauling (truck (45 tonne Moxies) annual travel estimates are acquired from provided traffic calcs. The remaining industrial vehicles are assumed to travel the length of the perimeter of the TSF boundary every year.
	Unpaved roads used by light duty vehicles - Input Value	1,113	Vehicle Kilometers Traveled (VKT)	Assumed to solely consider one service; assumed to travel the length of the perimeter of the TSF every week
	Wind Erosion - Input Value	13,140,000	ha-hrs	Assumed to apply 8,760 hours/year
use Gases	Site Personnel Travel Unpaved - Input Value	13,104	VKT	Based off 12 km approx. distance listed on traffic calcs, multiplied by 42 as the traffic calcs estimate 42 one-way trips per week, and multiplied by 52 to account for the annual amount.
	Daily Operational Time	24	hours/day	The Ok Birim Tailings Storage Facility Project Short Project Description for Technical Studies specifies that the operational phase will have work conducted 24 hrs/day 7 days/week.

Criteria Pollutant Inventories GHG Assumptions

	Parameter	Assumption/Value/Categorization	Unit/yr	Assumption/Basis/Source
TSF Operation Combustion Criteria Pollutants and Greenhouse Gases	Excavator (45 t) - Fuel Consumption	1,164,800	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Dozer (D8) - Fuel Consumption	582,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Diesel Generator (Genset 50kVA) - Fuel Consumption	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Gensets (11 MW installed capacity) - Fuel Consumption	11,200,000	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Crew bus (25-57 seater) - Fuel Consumption	218,400	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Dump Truck (20 t) - Fuel Consumption	2,184,000	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Four-wheel drive / Utes - Fuel Consumption	655,200	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Convoys Trucks (long haul semi-trailers) - Fuel Consumption	291,200	litres	Data acquired from Construction tab found on - DL_413_OTML-construction+operational-traffic-movements_TTC-calcs_Rev1
	Daily Operational Time	24	hours/day	The Ok Birim Tailings Storage Facility Project Short Project Description for Technical Studies specifies that the operational phase will have work conducted 24 hrs/day 7 days/week.
	Bulldozing	8,760	vehicle-hrs	The Ok Birim Tailings Storage Facility Project Short Project Description for Technical Studies specifies that the operational phase will have work conducted 24 hrs/day 7 days/week.

Criteria Pollutant Inventories GHG Assumptions

	Parameter	Assumption/Value/Categorization	Unit/yr	Assumption/Basis/Source
TSF Operation Dust Generation Criteria Pollutants	Excavating	187,000	Tonnes	Per the provided traffic calcs, it is estimated that an ongoing excavation for 20 years of 50,000 m ³ /year. Additionally a second excavation will be going on of 510,000 m ³ /year for the final two years of the operations phase. The meters cubed were converted by using the traffic calcs listed conversion factor of 1.7 tonnes/m ³ In order to account for all of the dust generated emissions, the secondary excavation expected in the final two years were spread out through the 20 years of the construction phase.
	Miscellaneous transfers	187,000	Tonnes	The weight conveyed during the operations phase is assumed to be equal to the excavated weight.
	Truck Unloading (dumping)	18,000,000	Tonnes	Based on the report listed total annual tailings produced by TPP, 10% of the total is subtracted as it is expected to be discharged into Ok Tedi due to the pipeline being offline for short periods of time
	Unpaved roads at development sites	10,824	Vehicle Kilometers Traveled (VKT)	Assumed to equal the numbers specified on the provided traffic calcs for gravel extraction numbers. Additionally, the remaining vehicles are assumed to travel the length of the TSF boundary every year.
	Wind Erosion	15,505,200	ha-hrs	Assumed to = (total area - reduced area during operations phase) * 8760 hrs/year
	Site Personnel Travel Unpaved	13,104	Vehicle Kilometers Traveled (VKT)	Assumed 1,092 one-way trips per year at an approximate average distance of 12 km, based on the provided traffic calculations.

Criteria Pollutants GHG Emissions Summary

Annual Criteria Pollutant Inventory (KG/YR)						
Project Phase	TSP	PM10	PM2.5	NOx	SO2	CO
Pipeline Construction	470,195.13	207,383.75	34,928.66	201,591.21	130.81	61,269.53
TSF Construction	2,055,904.92	962,912.35	107,566.76	169,655.45	142.88	59,600.05
TSF Operation	1,812,381.46	871,025.32	114,899.86	522,558.40	200.70	52,181.71

Total Criteria Pollutant Inventory (KG)						
Project Phase	TSP	PM10	PM2.5	NOx	SO2	CO
Pipeline Construction	1,410,585.39	622,151.24	104,785.98	604,773.62	392.42	183,808.59
TSF Construction	6,167,714.75	2,888,737.06	322,700.29	508,966.35	428.63	178,800.15
TSF Operation	36,247,629.13	17,420,506.49	2,297,997.28	10,451,168.00	4,014.08	1,043,634.14

Greenhouse Gas Inventory (t of GHG pollutant/year)				
Project Phase	t CO2e/GJ CO2	t CO2e/GJ CH4	t CO2e/GJ N2O	t CO2e/GJ Combined Gases
Pipeline Construction	17,481.79	30.65	98.35	17,610.79
TSF Construction	12,964.02	22.68	72.50	13,059.20
TSF Operation	44,558.16	68.27	166.83	44,793.27
Vegetation removal				1,000,350

Infrastructure Corridor Development Area - Criteria Pollutant Emissions Inventory

Combustion Sources	Emission Factors						Units	Input Value, Units as	Units/yr
	TSP	PM10	PM2.5	NOx	SO2	CO			
Transport Buses (22 seater) (3 units)	2.110E-03	2.110E-03	2.070E-03	3.040E-02	1.670E-05	9.110E-03	kg/litre	218,400	litres
Supt Vehicle (4 units)	3.960E-03	3.960E-03	3.663E-03	4.950E-02	2.633E-05	2.033E-02	kg/litre	291,200	litres
Excavator (6 units)	3.062E-03	3.062E-03	2.818E-03	3.465E-02	2.396E-05	9.504E-03	kg/litre	1,747,200	litres
Dump Truck (10 units)	1.840E-03	1.840E-03	1.730E-03	2.330E-02	1.670E-05	6.810E-03	kg/litre	2,184,000	litres
Dozer (D8) (4 units)	3.062E-03	3.062E-03	2.818E-03	3.465E-02	2.396E-05	9.504E-03	kg/litre	582,400	litres
Service Trucks (1 unit)	2.390E-03	2.390E-03	2.340E-03	8.890E-03	1.670E-05	1.940E-02	kg/litre	218,400	litres
Fuel Truck (1 unit)	1.840E-03	1.840E-03	1.730E-03	2.330E-02	1.670E-05	6.810E-03	kg/litre	218,400	litres
Pipe Loaders (3 units)	3.564E-03	3.564E-03	3.280E-03	3.894E-02	2.472E-05	1.198E-02	kg/litre	218,400	litres
Cranes (Franna) (3 units)	3.564E-03	3.564E-03	3.280E-03	3.894E-02	2.472E-05	1.198E-02	kg/litre	218,400	litres
Floater (1 unit)	1.640E-03	1.640E-03	1.600E-03	3.120E-02	8.300E-06	4.140E-07	kg/litre	72,800	litres
Gensets (kva)	5.100E-03	5.100E-03	4.980E-03	7.250E-02	1.670E-05	1.560E-02	kg/litre	218,400	litres
Convoy Trucks (6 units)	1.840E-03	1.840E-03	1.730E-03	2.330E-02	1.670E-05	6.810E-03	kg/litre	291,200	litres

Combustion Sources	Exposed Pipeline Emissions (kg/yr)					
	TSP	PM10	PM2.5	NOx	SO2	CO
Transport Buses (22 seater) (3 units)	461	461	452	6,639	3.65	1,990
Supt Vehicle (4 units)	1,153	1,153	1,067	14,414	7.67	5,920
Excavator (6 units)	5,351	5,351	4,924	60,540	41.86	16,605
Dump Truck (10 units)	4,019	4,019	3,778	50,887	36.47	14,873
Dozer (D8) (4 units)	1,784	1,784	1,641	20,180	13.95	5,535
Service Trucks (1 unit)	522	522	511	1,942	3.65	4,237
Fuel Truck (1 unit)	402	402	378	5,089	3.65	1,487
Pipe Loaders (3 units)	778	778	716	8,504	5.40	2,616
Cranes (Franna) (3 units)	778	778	716	8,504	5.40	2,616
Floater (1 unit)	119	119	116	2,271	0.60	0
Gensets (kva)	1,114	1,114	1,088	15,834	3.65	3,407
Convoy Trucks (6 units)	536	536	504	6,785	4.86	1,983

Dust Generating Sources	Quantity	Emission Factors			Units	Input Value	Units/yr	Dust Generated Emissions (kg/yr)		
		TSP	PM10	PM2.5				TSP	PM10	PM2.5
Bulldozing	4	17	4.1	0.41	kg/hr/vehicle	4,368	vehicle-hrs	297,024	71,635	7,164
Excavating	6	0.025	0.012	0.0012	kg/t	403,843.55	Tonnes	10,096	4,846	485
Miscellaneous transfer points	6	0.00032	0.00015	0.000015	kg/t/transfer point	47,943.72	Tonnes	15	7	1
Truck Unloading (dumping)	10	0.012	0.0043	0.00043	kg/t	403,843.55	Tonnes	4,846	1,737	174
Unpaved roads at development sites	21	4.23	1.25	0.125	kg/VKT	87	VKT	7,728	2,284	228
Unpaved roads used by light duty vehicles	1	0.94	0.33	0.033	kg/VKT	63,336	VKT	59,536	20,901	2,090
Wind Erosion	N/A	0.4	0.2	0.02	kg/ha/h	2,890,800	ha-hrs	1,156,320	578,160	57,816
Site Personnel Travel Unpaved Roads first half and second half	3	4.23	1.25	0.125	kg/VKT	21,840	VKT	277,150	81,900	8,190

Summary							
EMISSIONS FROM Pipeline FOOTPRINT (KG)	TSP	PM10	PM2.5	NOx	SO2	CO	Units
Combustion Sources	17,016	17,016	15,892	201,591	131	61,270	KG/YR
Dust Generating Sources w/ 75% rain control	453,179	190,367	19,037	-	-	-	KG/YR
TOTAL ANNUAL EMISSIONS	470,195	207,384	34,929	201,591	131	61,270	KG/YR
Total Emissions For Construction Phase	1,410,585	622,151	104,786	604,774	392	183,809	KG/3YRS

Infrastructure Coridor Development Area - GHG Inventory

Combustion Sources	Scope 1 Emission Factors, Units as noted				Energy Content Factor (GJ/kL)	Input Value, Units as noted	Units/yr	Input Value as Kiloliters	References
	kg CO2e/GJ Combined Gases	kg CO2e/GJ CO2	kg CO2e/GJ CH4	kg CO2e/GJ N2O					Australian National Greenhouse Accounts Factors 2025 Reference
Transport Buses (22 seater) (3 units)	70.4233	69.9	0.1233	0.4	38.6	218,400	liters	218.40	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Sup Vehicle (3 units)	70.4233	69.9	0.1233	0.4	38.6	291,200	liters	291.20	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Excavator (45t) (6 units)	70.4233	69.9	0.1233	0.4	38.6	1,747,200	liters	1,747.20	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Dump Truck (10 units)	70.4233	69.9	0.1233	0.4	38.6	2,184,000	liters	2,184.00	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Dozer (D8) (4 units)	70.4233	69.9	0.1233	0.4	38.6	582,400	liters	582.40	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Service Trucks (1 unit)	70.4233	69.9	0.1233	0.4	38.6	218,400	liters	218.40	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Fuel Truck (1 unit)	70.4233	69.9	0.1233	0.4	38.6	218,400	liters	218.40	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Pipe Loaders (3 units)	70.4233	69.9	0.1233	0.4	38.6	218,400	liters	218.40	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Cranes (Franna) (3 units)	70.4233	69.9	0.1233	0.4	38.6	218,400	liters	218.40	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Floater (1 unit)	70.4233	69.9	0.1233	0.4	38.6	72,800	liters	72.80	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Genset 1250 kVA 415V (1)	70.2000	69.9	0.1000	0.2	38.6	218,400	liters	218.40	Stationary Combustion of Liquid Fuels - Diesel Oil, Table 8
Convoy Trucks (6 units)	70.4233	69.9	0.1233	0.4	38.6	291,200	liters	291.20	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9

Combustion Sources	Scope 1 Emissions			
	t CO2e/GJ Combined Gases	t CO2e/GJ CO2	t CO2e/GJ CH4	t CO2e/GJ N2O
Transport Buses (22 seater) (3 units)	593.7	589.3	1.0	3.37
Sup Vehicle (3 units)	791.6	785.7	1.4	4.50
Excavator (45t) (6 units)	4,749.5	4,714.2	8.3	26.98
Dump Truck (10 units)	5,936.9	5,892.7	10.4	33.72
Dozer (D8) (4 units)	1,583.2	1,571.4	2.8	8.99
Service Trucks (1 unit)	593.7	589.3	1.0	3.37
Fuel Truck (1 unit)	593.7	589.3	1.0	3.37
Pipe Loaders (3 units)	593.7	589.3	1.0	3.37
Cranes (Franna) (3 units)	593.7	589.3	1.0	3.37
Floater (1 unit)	197.9	196.4	0.3	1.12
Genset 1250 kVA 415V (1)	591.8	589.3	0.8	1.69
Convoy Trucks (6 units)	791.6	785.7	1.4	4.50
Totals	17,610.8	17,481.8	30.6	98.35

TSF Development Area - Criteria Pollutant Emissions Inventory

Combustion Sources	Emission Factors						Units	Input Value, Units as noted	Units/yr
	TSP	PM10	PM2.5	NOx	SO2	CO			
Transport Buses (22 seater) (3 units)	2.1100E-03	2.1100E-03	2.0700E-03	3.0400E-02	1.6700E-05	0.00911	kg/litre	218,400	litres
Supt Vehicle (4 units)	3.9930E-03	3.9930E-03	3.6630E-03	4.9500E-02	2.6334E-05	0.020328	kg/litre	291,200	litres
Excavator (45t) (3 units)	3.0624E-03	3.0624E-03	2.8182E-03	3.4650E-02	2.3958E-05	0.009504	kg/litre	873,600	litres
Trucks (45 tonne Moxies) (6 units)	2.2209E-03	2.2209E-03	2.0427E-03	3.5970E-02	2.5509E-05	0.01551	kg/litre	1,310,400	litres
Dozer (D8) (3 units)	3.0690E-03	3.0690E-03	2.8050E-03	3.4650E-02	2.3958E-05	0.009504	kg/litre	436,800	litres
Service Trucks (1 unit)	2.3900E-03	2.3900E-03	2.3400E-03	8.8900E-03	1.6700E-05	0.0194	kg/litre	218,400	litres
Fuel Truck (1 unit)	1.8400E-03	1.8400E-03	1.7300E-03	2.3300E-02	1.6700E-04	0.00681	kg/litre	218,400	litres
Grader (2)	2.7654E-03	2.7654E-03	2.5443E-03	3.1581E-02	2.4717E-05	0.006798	kg/litre	145,600	litres
Mobile Crushing Plant (2 units)	3.4980E-03	3.4980E-03	3.2175E-03	3.3000E-02	2.5509E-05	0.010824	kg/litre	145,600	litres
Wheel Loader (3 units)	3.5640E-03	3.5640E-03	3.2802E-03	3.8940E-02	2.4717E-05	0.011979	kg/litre	218,400	litres
IT Loader (3 units)	3.5640E-03	3.5640E-03	3.2802E-03	3.8940E-02	2.4717E-05	0.011979	kg/litre	218,400	litres
Genset (50kva) (3 units)	5.1000E-03	5.1000E-03	4.9800E-03	7.2500E-02	1.6700E-05	0.0156	kg/litre	218,400	litres
Convoy Trucks (6)	1.8400E-03	1.8400E-03	1.7300E-03	2.3300E-02	1.6700E-05	0.00681	kg/litre	291,200	litres

Combustion Sources	Combustion Emissions (kg/yr)					
	TSP	PM10	PM2.5	NOx	SO2	CO
Transport Buses (22 seater) (3 units)	461	461	452	6,639	3.65	1,990
Supt Vehicle (4 units)	1,163	1,163	1,067	14,414	7.67	5,920
Excavator (45t) (3 units)	2,675	2,675	2,462	30,270	20.93	8,303
Trucks (45 tonne Moxies) (6 units)	2,910	2,910	2,677	47,135	33.43	20,324
Dozer (D8) (3 units)	1,341	1,341	1,225	15,135	10.46	4,151
Service Trucks (1 unit)	522	522	511	1,942	3.65	4,237
Fuel Truck (1 unit)	402	402	378	5,089	36.47	1,487
Grader (2)	403	403	370	4,598	3.60	990
Mobile Crushing Plant (2 units)	509	509	468	4,805	3.71	1,576
Wheel Loader (3 units)	778	778	716	8,504	5.40	2,616
IT Loader (3 units)	778	778	716	8,504	5.40	2,616
Genset (50kva) (3 units)	1,114	1,114	1,088	15,834	3.65	3,407
Convoy Trucks (6)	536	536	504	6,785	4.86	1,983

Dust Generating Sources	Quantity	Emission Factors			Units	Input Value, Units as noted	Units/yr	Dust Emissions (kg/yr)		
		TSP	PM10	PM2.5				TSP	PM10	PM2.5
Bulldozing	4	17	4.1	0.41	kg/hr/vehicle	4,368	vehicle-hrs	297,024.00	71,635.20	7,163.52
Excavating	3	0.025	0.012	0.0012	kg/t	69,500,000	tonnes	1,737,500.00	834,000.00	83,400.00
Graders	2	0.19	0.085	0.0085	kg/VKT	1,113	VKT	422.86	189.18	18.92
Miscellaneous transfers	6	0.00032	0.00015	0.000015	kg/t/transfer point	69,500,000	tonnes	22,240.00	10,425.00	1,042.50
Unpaved roads at development sites	13	4.23	1.25	0.125	kg/VKT	189,028	VKT	799,589.29	236,285.25	23,628.53
Unpaved roads used by light duty vehicles	1	0.94	0.33	0.033	kg/VKT	1,113	VKT	1,046.03	367.22	36.72
Wind Erosion	N/A	0.4	0.2	0.02	kg/ha/h	13,140,000	ha-hrs	5,256,000.00	2,628,000.00	262,800.00
Site Personnel Travel Unpaved	3	4.23	1.25	0.125	kg/VKT	13,104	VKT	55,429.92	16,380.00	1,638.00

Summary							
EMISSIONS FROM TSF FOOTPRINT (KG)	TSP	PM10	PM2.5	NOx	SO2	CO	Units
Combustion Sources	13,591.9	13,591.9	12,634.7	169,655.4	142.9	59,600.0	KG/YR
Dust Generating Sources w/ 75% rain control	2,042,313.0	949,320.5	94,932.0	-	-	-	KG/YR
TOTAL ANNUAL EMISSIONS	2,055,904.9	962,912.4	107,566.8	169,655.4	142.9	59,600.0	KG/YR
Total Emissions For Development Phase	6,167,714.75	2,888,737.06	322,700.29	508,966.35	428.63	178,800.15	KG/3YRS

TSF Development Area - GHG Inventory

Combustion Sources	Scope 1 Emission Factors, Units as noted				Energy Content Factor (GJ/kL)	Input Value, Units as noted	Units/yr	Input Value as Kiloliters	References
	kg CO2e/GJ Combined Gases	kg CO2e/GJ CO2	kg CO2e/GJ CH4	kg CO2e/GJ N2O					Australian National Greenhouse Accounts Factors 2025 Reference
Transport Buses (22 seater) (3 units)	70.423	69.9	0.123	0.4	38.6	218,400	liters	218.40	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Supt Vehicle (3 units)	70.423	69.9	0.123	0.4	38.6	291,200	liters	291.20	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Excavator (45t) (6 units)	70.423	69.9	0.123	0.4	38.6	873,600	liters	873.60	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Trucks (45 tonne Moxies) (6 units)	70.423	69.9	0.123	0.4	38.6	1,310,400	liters	1,310.40	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Dozer (D8) (4 units)	70.423	69.9	0.123	0.4	38.6	436,800	liters	436.80	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Service Trucks (1 unit)	70.423	69.9	0.123	0.4	38.6	218,400	liters	218.40	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Fuel Truck (1 unit)	70.423	69.9	0.123	0.4	38.6	218,400	liters	218.40	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Grader (2)	70.423	69.9	0.123	0.4	38.6	145,600	liters	145.60	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Mobile Crushing Plant (2 units)	70.423	69.9	0.123	0.4	38.6	145,600	liters	145.60	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Wheel Loader (3 units)	70.423	69.9	0.123	0.4	38.6	218,400	liters	218.40	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
IT Loader (3 units)	70.423	69.9	0.123	0.4	38.6	218,400	liters	218.40	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9
Genset (50kva) (3 units)	70.423	69.9	0.100	0.2	38.6	218,400	liters	218.40	Stationary Combustion of Liquid Fuels - Diesel Oil, Table 8
Convoy Trucks (6)	70.423	69.9	0.123	0.4	38.6	291,200	liters	291.20	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9

Combustion Sources	Scope 1 Emissions			
	t CO2e/GJ Combined Gases	t CO2e/GJ CO2	t CO2e/GJ CH4	t CO2e/GJ N2O
Transport Buses (22 seater) (3 units)	593.7	589.3	1.0	3.37
Supt Vehicle (3 units)	791.6	785.7	1.4	4.50
Excavator (45t) (6 units)	2,374.7	2,357.1	4.2	13.49
Trucks (45 tonne Moxies) (6 units)	3,562.1	3,535.6	6.2	20.23
Dozer (D8) (4 units)	1,187.4	1,178.5	2.1	6.74
Service Trucks (1 unit)	593.7	589.3	1.0	3.37
Fuel Truck (1 unit)	593.7	589.3	1.0	3.37
Grader (2)	395.8	392.8	0.7	2.25
Mobile Crushing Plant (2 units)	395.8	392.8	0.7	2.25
Wheel Loader (3 units)	593.7	589.3	1.0	3.37
IT Loader (3 units)	593.7	589.3	1.0	3.37
Genset (50kva) (3 units)	593.7	589.3	0.8	1.69
Convoy Trucks (6)	791.6	785.7	1.4	4.50
Totals	13,059.2	12,964.0	22.7	72.50

TSF Operation - Criteria PollutantEmissions Inventory

Combustion Sources	Quantity	Emission Factors						Units	Input Value	Units/yr
		TSP	PM10	PM2.5	NOx	SO2	CO			
Excavator (45 t)	4	3.07E-03	3.07E-03	2.81E-03	3.47E-02	2.40E-05	9.50E-03	kg/litre	1,164,800	litres
Dozer (D8)	4	3.07E-03	3.07E-03	2.81E-03	3.47E-02	2.40E-05	9.50E-03	kg/litre	582,400	litres
Diesel Generator (Genset 50kVA)	3	5.10E-03	5.10E-03	4.98E-03	7.25E-02	1.67E-05	1.56E-02	kg/litre	218,400	litres
Gensets (11 MW installed capacity)	10 (2 on standby)	1.64E-03	1.64E-03	1.60E-03	3.12E-02	8.30E-06	4.14E-07	kg/litre	11,200,000	litres
Crew bus (25-57 seater)	3	2.11E-03	2.11E-03	2.07E-03	3.04E-02	1.67E-05	9.11E-03	kg/litre	218,400	litres
Dump Truck (20 t)	10	1.84E-03	1.84E-03	1.73E-03	2.33E-02	1.67E-05	6.81E-03	kg/litre	2,184,000	litres
Supt Vehicle	9	3.96E-03	3.96E-03	3.66E-03	4.95E-02	2.63E-05	2.03E-02	kg/litre	655,200	litres
Convoys Trucks (long haul semi-trailers)	6	1.84E-03	1.84E-03	1.73E-03	2.33E-02	1.67E-05	6.81E-03	kg/litre	291,200	litres

Combustion Sources	Emissions (kg/yr)					
	TSP	PM10	PM2.5	NOx	SO2	CO
Excavator (45 t)	3,575	3,575	3,267	40,360	27.9	11,070
Dozer (D8)	1,787	1,787	1,634	20,180	14.0	5,535
Diesel Generator (Genset 50kVA)	1,114	1,114	1,088	15,834	3.6	3,407
Gensets (11 MW installed capacity)	18,368	18,368	17,920	349,440	93.0	5
Crew bus (25-57 seater)	461	461	452	6,639	3.6	1,990
Dump Truck (20 t)	4,019	4,019	3,778	50,887	36.5	14,873
Supt Vehicle	2,595	2,595	2,400	32,432	17.3	13,319
Convoys Trucks (long haul semi-trailers)	536	536	504	6,785	4.9	1,983

Dust Generating Sources	Quantity	Emission Factors			Units	Input Value	Units/yr	Emissions (kg/yr)		
		TSP	PM10	PM2.5				TSP	PM10	PM2.5
Bulldozing	4	17	4.1	0.41	kg/hr/vehicle	8,760	vehicle-hrs	595,680	143,664	14,366
Excavating	4	0.025	0.012	0.0012	kg/t	187,000	tonnes	4,675	2,244	224
Miscellaneous transfers	6	3.20E-04	1.50E-04	1.50E-05	kg/t/transfer	187,000	tonnes	60	28	3
Truck Unloading (dumping)	10	1.20E-02	4.30E-03	4.30E-04	kg/t	18,000,000	tonnes	216,000	77,400	7,740
Unpaved roads at development sites	19	4.23	1.25	0.125	kg/VKT	10,824	VKT	45,786	13,530	1,353
Wind Erosion	N/A	0.4	0.2	0.02	kg/ha/h	15,505,200	hectare hrs	6,202,080	3,101,040	310,104
Site Personnel Travel Unpaved	3	4.23	1.25	0.125	kg/VKT	13,104	VKT	55,430	16,380	1,638

Summary							
EMISSIONS FROM TSF FOOTPRINT (KG)	TSP	PM10	PM2.5	NOx	SO2	CO	Units
Combustion Sources	32,454	32,454	31,043	522,558	201	52,182	KG/YR
Dust Generating Sources w/ 75% rain control	1,779,928	838,572	83,857	-	-	-	KG/YR
TOTAL ANNUAL EMISSIONS	1,812,381	871,025	114,900	522,558	201	52,182	KG/YR
Total Emissions For Operations Phase	36,247,629	17,420,506	2,297,997	10,451,168	4,014	1,043,634	KG/20YRS

TSF Operation - GHG Inventory										
Combustion Sources	Scope 1 Emission Factors, Units as noted				Energy Content Factor (GJ/kL)	Input Value	Units/year	Input Value as Kiloliters	References	
	kgCO2e/GJ CO2	kgCO2e/GJ CH4	kgCO2e/GJ N2O	kg CO2e/GJ Combined Gases					Australian National Greenhouse Accounts Factors 2025 Reference	
Excavator (4 units)	70	0.12	0.4	70.42	38.6	1,164,800	liters	1164.8	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9	
Dozer (4 units)	70	0.12	0.4	70.42	38.6	582,400	liters	582.4	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9	
Diesel Generator (Genset 50kVA) (3 units)	70	0.10	0.2	70.20	38.6	218,400	liters	218.4	Stationary Combustion of Liquid Fuels - Diesel Oil, Table 8	
Gensets (11 MW installed capacity)	70	0.10	0.2	70.20	38.6	11,200,000	liters	11200	Stationary Combustion of Liquid Fuels - Diesel Oil, Table 8	
Bus (3 units)	70	0.12	0.4	70.42	38.6	218,400	liters	218.4	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9	
Dump Trucks (10 units)	70	0.12	0.4	70.42	38.6	2,184,000	liters	2184	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9	
Supt vehicle	70	0.12	0.4	70.42	38.6	655,200	liters	655.2	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9	
Convoy Trucks (6 units)	70	0.12	0.4	70.42	38.6	291,200	liters	291.2	Transport Fuel Emissions - Heavy duty vehicles: Diesel oil, Table 9	

Combustion Sources	Scope 1 Emissions			
	t CO2e/GJ CO2	t CO2e/GJ CH4	t CO2e/GJ N2O	t CO2e/GJ Combined Gases
Excavator (4 units)	3143	5.5	18.0	3166
Dozer (4 units)	1571	2.8	9.0	1583
Diesel Generator (Genset 50kVA) (3 units)	589	0.8	1.7	592
Gensets (11 MW installed capacity)	30219	43.2	86.5	30349
Bus (3 units)	589	1.0	3.4	594
Dump Trucks (10 units)	5893	10.4	33.7	5937
Supt vehicle	1768	3.1	10.1	1781
Convoy Trucks (6 units)	786	1.4	4.5	792
Total	44558	68.27	166.83	44793

Ok Tedi Land Clearing Emissions			
Factor	Value	Unit	Description
As,t		1900 ha	Area of the stratum in year t
Bab,tree		350 t/ha	Average above ground biomass stock of tree vegetation
Bab,shrub		350 t/ha	Average above ground biomass stock of shrub vegetation
Rtree		0.37	Average root:shoot ratio appropriate for biomass stocks, for tree vegetation
Rshrub		0.37	Average root:shoot ratio appropriate for biomass stocks, for shrub vegetation
CFtree		0.50	Average carbon fraction of biomass for tree vegetation
CFshrub		0.49	Average carbon fraction of biomass for shrub vegetation
		44/12	Conversion factor: ratio of molecular weights of CO2 and C; mol/mol
		3 2/3	
Equation 2	Lsp,tree,t	455,525.00 t C	
Equation 3	Lsp,shrub,t	446,414.50 t C	
Equation 1	Ebiomassloss, t	3,307,111.50 t CO2	increase in CO2 emissions from loss of biomass in existing vegetation as a result of site preparation

Methodology Tool [Estimation of GHG Emissions due to clearing, burning, and decay of existing vegetation attributable to a CDM A/R project activity](#)

Key Factors in Calculation of Biomass Losses

Factors	Value	Source	
Climate Region	TAr (Tropical Rain Forest)	2066 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4. Agriculture, Forestry, and Other Land Use	Vol. 4 Chapter 4, IPCC (2006)
Carbon Fraction of biomass for tree vegetation (CFtree)	0.50 tonnes C/tonne dm	Estimation of GHG Emissions due to clearing, burning, and decay of existing vegetation attributable to a CDM A/R project activity	IPCC default value
Carbon Fraction of biomass for shrub vegetation (CFshrub)	0.49 tonnes C/tonne dm	Estimation of GHG Emissions due to clearing, burning, and decay of existing vegetation attributable to a CDM A/R project activity	IPCC default value
Root:shoot ration for biomass stocks for tree vegetation (Rtree)	0.37	2066 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4. Agriculture, Forestry, and Other Land Use	Table 4.4 Vol. 4 Chapter 4, IPCC (2006)
Root:shoot ration for biomass stocks for shrub vegetation (Rshrub)	0.37	2066 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4. Agriculture, Forestry, and Other Land Use	Table 4.4 Vol. 4 Chapter 4, IPCC (2006)
Average above ground biomass stock of tree vegetation (Bab,tree)	350 t/ha	2066 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4. Agriculture, Forestry, and Other Land Use	Table 4.7 Vol. 4 Chapter 4, IPCC (2006)
Average above ground biomass stock of shrub vegetation (Bab,shrub)	350t/ha	2066 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4. Agriculture, Forestry, and Other Land Use	Table 4.7 Vol. 4 Chapter 4, IPCC (2006)

II. ESTIMATION OF EMISSIONS DUE TO CLEARING, BURNING AND DECAY OF EXISTING VEGETATION

5. An A/R CDM project activity may involve the partial or total clearance (including by burning) of existing vegetation as a result of site preparation. Alternatively, competition from forest or other vegetation established as part of A/R project activities can result in the death and decay of existing vegetation. These losses of existing biomass are treated as an increase in GHG emissions within the project boundary. In general, emissions from loss of existing biomass will occur as two components: emissions of CO₂ and non-CO₂ from biomass burning if “slash-and-burn” practices are used and emissions of CO₂ from decay of remaining burned and/or unburned vegetation.

6. To provide a simplified approach to estimation of CO₂ and non-CO₂ emissions associated with site preparation, the conservative default factors provided in Table 1 as derived from the IPCC literature can be used.

Table 1: The conservative default factors derived from the IPCC literature

Factor	Value	Description
CF _{tree}	0.50 t C (t d.m.) ⁻¹	Average carbon fraction of biomass for tree vegetation
CF _{shrub}	0.49 t C (t d.m.) ⁻¹	Average carbon fraction of biomass for shrub vegetation
f _{BL, tree}	0.4 t d.m. (t d.m.) ⁻¹	The fraction of biomass of tree vegetation left to decay after burning
f _{BL, shrub}	0.05 t d.m. (t d.m.) ⁻¹	The fraction of biomass of shrub vegetation left to decay after burning
R _{tree}	0.3 t d.m. (t d.m.) ⁻¹	Average root:shoot ratio appropriate for biomass stocks, for tree vegetation
R _{shrub}	0.4 t d.m. (t d.m.) ⁻¹	Average root:shoot ratio appropriate for biomass stocks, for shrub vegetation

The CO₂ emissions for each stratum in year *t* are given by:

$$E_{BiomassLoss,t} = \left(L_{SP,tree,t} + L_{SP,shrub,t} \right) \frac{44}{12} \tag{1}$$

and:

$$L_{SP,tree,t} = A_{S,t} B_{AB,tree} \left(1 + R_{tree} \right) CF_{tree} \tag{2}$$

$$L_{SP,shrub,t} = A_{S,t} B_{AB,shrub} \left(1 + R_{shrub} \right) CF_{shrub} \tag{3}$$

where:	
E _{BiomassLoss}	Increase in CO ₂ emissions from loss of biomass in existing vegetation as a result of site preparation; t CO ₂
L _{SP}	Carbon stock loss in existing tree or shrub vegetation (as indicated by subscripts in equations) as a result of site preparation in year <i>t</i> ; t C
A _{S,t}	Area of the stratum in year <i>t</i> (If fire is used as part of site preparation the area burned shall be defined as a stratum, and all biomass in the stratum is considered to be burned); ha
B _{AB}	Average above-ground biomass stock of tree or shrub vegetation (as indicated by subscripts in equations); t d.m. ha ⁻¹
R	Average root:shoot ratio appropriate for biomass stocks, for tree or shrub vegetation (as indicated by subscripts in equations); t d.m. ha ⁻¹ (t d.m. ha ⁻¹) ⁻¹
CF	Average carbon fraction of biomass for tree or shrub vegetation (as indicated by subscripts in equations); t C (t d.m.) ⁻¹ . IPCC default values for tree and shrub vegetation, respectively, are: 0.50, 0.49
44/12	Conversion factor: ratio of molecular weights of CO ₂ and C; mol mol ⁻¹

Ok Tedi Land Clearing Emissions			
Factor	Value	Unit	Description
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Methodology Tool [Estimation of GHG Emissions due to clearing, burning, and decay of existing vegetation attributable to a CDM A/R project activity](#)

Key Factors in Calculation of Biomass Losses

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Carbon Fraction of biomass for shrub vegetation (CFshrub)	0.49 tonnes C/tonne dm	Estimation of GHG Emissions due to clearing, burning, and decay of existing vegetation attributable to a CDM A/R project activity	IPCC default value
Root:shoot ration for biomass stocks for tree vegetation (Rtree)	0.37	2066 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4. Agriculture, Forestry, and Other Land Use	Table 4.4 Vol. 4 Chapter 4, IPCC (2006)
Root:shoot ration for biomass stocks for shrub vegetation (Rshrub)	0.37	2066 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4. Agriculture, Forestry, and Other Land Use	Table 4.4 Vol. 4 Chapter 4, IPCC (2006)
Average above ground biomass stock of tree vegetation (Bab,tree)	350 t/ha	2066 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4. Agriculture, Forestry, and Other Land Use	Table 4.7 Vol. 4 Chapter 4, IPCC (2006)
Average above ground biomass stock of shrub vegetation (Bab,shrub)	350t/ha	2066 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4. Agriculture, Forestry, and Other Land Use	Table 4.7 Vol. 4 Chapter 4, IPCC (2006)

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f _{BL, shrub}	0.05 t d.m. (t d.m.) ⁻¹	The fraction of biomass of shrub vegetation left to decay after burning
R _{tree}	0.3 t d.m. (t d.m.) ⁻¹	Average root:shoot ratio appropriate for biomass stocks, for tree vegetation
R _{shrub}	0.4 t d.m. (t d.m.) ⁻¹	Average root:shoot ratio appropriate for biomass stocks, for shrub vegetation

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and:

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$$L_{SP,shrub,t} = A_{S,t} B_{AB,shrub} \left(1 + R_{shrub} \right) CF_{shrub} \tag{3}$$

where:

$E_{BiomassLoss}$	Increase in CO ₂ emissions from loss of biomass in existing vegetation as a result of site preparation; t CO ₂
L_{SP}	Carbon stock loss in existing tree or shrub vegetation (as indicated by subscripts in equations) as a result of site preparation in year <i>t</i> ; t C
$A_{S,t}$	Area of the stratum in year <i>t</i> (If fire is used as part of site preparation the area burned shall be defined as a stratum, and all biomass in the stratum is considered to be burned); ha
B_{AB}	Average above-ground biomass stock of tree or shrub vegetation (as indicated by subscripts in equations); t d.m. ha ⁻¹
R	Average root:shoot ratio appropriate for biomass stocks, for tree or shrub vegetation (as indicated by subscripts in equations); t d.m. ha ⁻¹ (t d.m. ha ⁻¹) ⁻¹
CF	Average carbon fraction of biomass for tree or shrub vegetation (as indicated by subscripts in equations); t C (t d.m.) ⁻¹ . IPCC default values for tree and shrub vegetation, respectively, are: 0.50, 0.49
$\frac{44}{12}$	Conversion factor: ratio of molecular weights of CO ₂ and C; mol mol ⁻¹