

Jet Zero™

AIR QUALITY
ASSESSMENT



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Jet Zero Australia (Jet Zero) Pty Ltd

Project Ulysses

Air Quality Assessment

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Executive Summary

The Project Ulysses (the Project), is being developed by Jet Zero Australia Pty Ltd (Jet Zero), with the aim to construct Australia's first Alcohol-To-Jet (ATJ) plant converting ethanol feedstock into Sustainable Aviation Fuel (SAF) at Townsville, Queensland.

Vipac Engineers & Scientists have been engaged by Jet Zero to prepare an air quality assessment of the Project based on information and data available for the current pre-FEED engineering design phase intended to assist project execution, inform the environmental assessment reports and reduce risk.

The overall approach to the assessment follows the guidelines outlined in the Air—EIS information guideline 2024 and Applications for activities with impacts to air 2024 prepared by DESI and the CALPUFF modelling guidance 2011. The assessment was conducted as follows:

- An emissions inventory of the primary air pollutants emitted by the proposed Project for maximum operating scenarios has been developed. Air emission rates required for the modelling assessment are derived and scaled by a factor of approximately three based upon data provided for the LanzaJet's commercial-scale 38 ML pa Freedom Pines Fuels Plant, internationally recognised emissions estimation techniques (e.g. NPI EET or USEPA AP42 Methodology) and/or Vipac's database of similar projects.
- The emissions data was used as input for air dispersion modelling. The modelling techniques were based on a combination of The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the CALMET model suite used to generate a three-dimensional meteorological dataset for use in the CALPUFF dispersion model.
- The atmospheric dispersion modelling results were assessed by comparison with relevant assessment criteria.

The construction schedule and associated equipment are not known at this stage. These construction activities are inherently temporary and potential off-site impacts upon air quality (primarily as dust) are typically addressed and controlled based upon a construction management plan. In addition, the closest sensitive receptors are approximately 2.2km from the site boundary such that impacts upon dust levels at these locations are not expected.

It is noted that operation of the flare is not proposed as continuous during routine operations and non-routine operations include worst-case conditions that may result, for example, during commissioning, start up and emergency or worst-case maximum flaring.

The operational emissions scenarios adopted for the assessment are based upon emergency flare relief (or maximum release worst-case) scenarios as identified and reported for the Project Flare and Waste Stream Study as follows:

- Scenario 1 - Cooling Water Failure (if implemented) - Loss of cooling water in coolers/condensers. Can affect all equipment using cooling water at the same time.
- Scenario 2 - Total Electric Power Failure
- Scenario 3 - Closed Outlet Overfilling - Closure of a block valve (or similar) on a gas outlet line of a pressure vessel. Closure of a block valve (or similar) on liquid outline line of a pressure vessel.
- Scenario 4 - Start-up

These scenarios are conservatively modelled as continuous emissions despite the expected frequencies of each scenario to be much less of the order of once per year.

In addition, the emissions scenarios incorporate continuous operation of a natural-gas fired boiler.

The results of the modelling assessment may be summarised as follows:

- the predicted concentrations of all of the pollutants modelled are below the criteria at all of the modelled sensitive receptors (e.g. residential, commercial and ecological) for all scenarios.

Furthermore, the modelled scenarios represent worst-case emergency release events which are expected to be infrequent and of short duration.

Overall, based upon the Project design information provided, the modelling results indicate that the operation of the Project will not adversely impact the amenity of any sensitive receptors. In addition, distances of the sensitive (e.g. residential, commercial and ecological) receptors from the construction activities are anticipated to be large enough such that impacts on air quality from them are expected to be meet relevant criteria at the receptors.

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1 Introduction

Project Ulysses (the Project), is developed by Jet Zero Australia Pty Ltd (Jet Zero), with the aim to construct Australia's first Alcohol-To-Jet (ATJ) plant converting ethanol feedstock into Sustainable Aviation Fuel (SAF) at Townsville, Queensland. The Project includes a plant to convert ethanol derived from sustainably certified feedstocks such as agricultural byproducts including waste wheat starch, to SAF and Renewable Diesel (RD) using the LanzaJet ATJ Process. The plant will have a capacity to process a nominal 183 million litres-per-year (MLPY) of ethanol into 100MLPY of SAF and 11MLPY of RD as the primary case.

The plant consists of two (2) main elements: licensor process and utilities and tankage. Jet Zero has partnered with technology provider and licensor, LanzaJet, to provide the licensor process scope of the ATJ facility. Jet Zero have contracted Technip, a tier 1 global EPC contractor to undertake Pre-FEED and Front-End Engineering Design (FEED) integrating the licensor process with the utilities and tankage requirements. The facility will also include infrastructure for transport (road access and potential pipelines connection), powerline, telecommunications, water, and wastewater connections. This document outlines an air quality assessment of the Project prepared by Vipac Engineers & Scientists. It is noted that the assessment is based on information and data available for the current pre-FEED engineering design phase and is intended to assist project execution, inform the environmental assessment reports and reduce risk.

2 Project Context

2.1 Site Description

The Project is to be located on Lot 35 on SP341877 within Stage 3 (area 35) of the Cleveland Bay Industrial Park (CBIP) of the Townsville State Development Area (SDA) Development Scheme, which is facilitated by the Coordinator General (CG), an Agency of the Queensland Government.

Figure 2-1 shows the site location in relation to Townsville and surrounds.



Figure 2-1 - Site Location

2.2 Project Description

The Project is currently within the Pre-FEED engineering design phase following the Early Contractor Involvement (ECI) with contractors to improve project execution, inform the environmental assessment reports and reduce risk.

The primary reference plant for Project Ulysses is LanzaJet's commercial-scale 38 ML pa Freedom Pines Fuels Plant, in the United States, which will commence operations in 2024 producing SAF and RD. Implementing a modular design, Jet Zero's Project Ulysses will scale up production capacity approximately three times from the Freedom Pines Fuels Plant to a total production capacity of 111 ML pa.

The LanzaJet process is a leading, globally recognised ATJ technology. It is the world's first integrated process technology that uses low-carbon, sustainable bioethanol as the feedstock to produce SAF and RD. The technology was developed and scaled-up by LanzaTech over a decade and originated with the Pacific Northwest National Laboratory, a US Department of Energy (US DOE) National Laboratory.

To produce synthetic paraffinic kerosene (SPK), better known as SAF, LanzaJet's ATJ-SPK process follows the American Society for Testing and Materials (ASTM) Standard D7566 Annex A5 pathway. The process also produces synthetic paraffinic diesel (SPD), also referred to as RD. LanzaJet SAF and SPD/RD produced from the Project will meet ASTM standards, the standards applicable to Australian fuels. The SAF product has very similar properties to conventional jet fuel produced from fossil fuels but has superior environmental and performance features because it has a higher energy density, does not contain any aromatics and has very low sulphur levels.

LanzaJet, established in 2020, has exclusive rights to the technology, its further development, and its global commercialization and deployment. The process consists of:

- Ethanol purification and dehydration to ethylene
- Oligomerization of ethylene to fuel-range iso-olefins
- Saturation of the iso-olefins by hydrogenation
- Separation of SPK and SPD.

The LanzaJet ATJ process is configured to minimise energy, water, and utility consumption via a highly heat integrated process, and consequently minimise its GHG emissions.

The Project will receive feedstock including the following:

- Ethanol feedstock derived from agricultural byproducts such as waste wheat starch will be sourced for conversion to SAF and RD.
- The expectation is that all feedstock ethanol will be

Resulting in the following plant production:

- Sustainable Aviation Fuel (SAF): 100 ML per year.
- Renewable Diesel (RD): 11 ML per year.
- Plant feedstock of 144,700 tonnes/183 ML of anhydrous ethanol per year.

To facilitate the production of SAF, ethanol will be received via ship at the Port of Townsville and transported to site via B-doubles. SAF will then be transported from site via trucks (potentially B-doubles) to local airports or to the Port for export. Access to the facility will be via future access roads via Ron McLean Drive.

A project block flow diagram is provided in Figure 2-2.

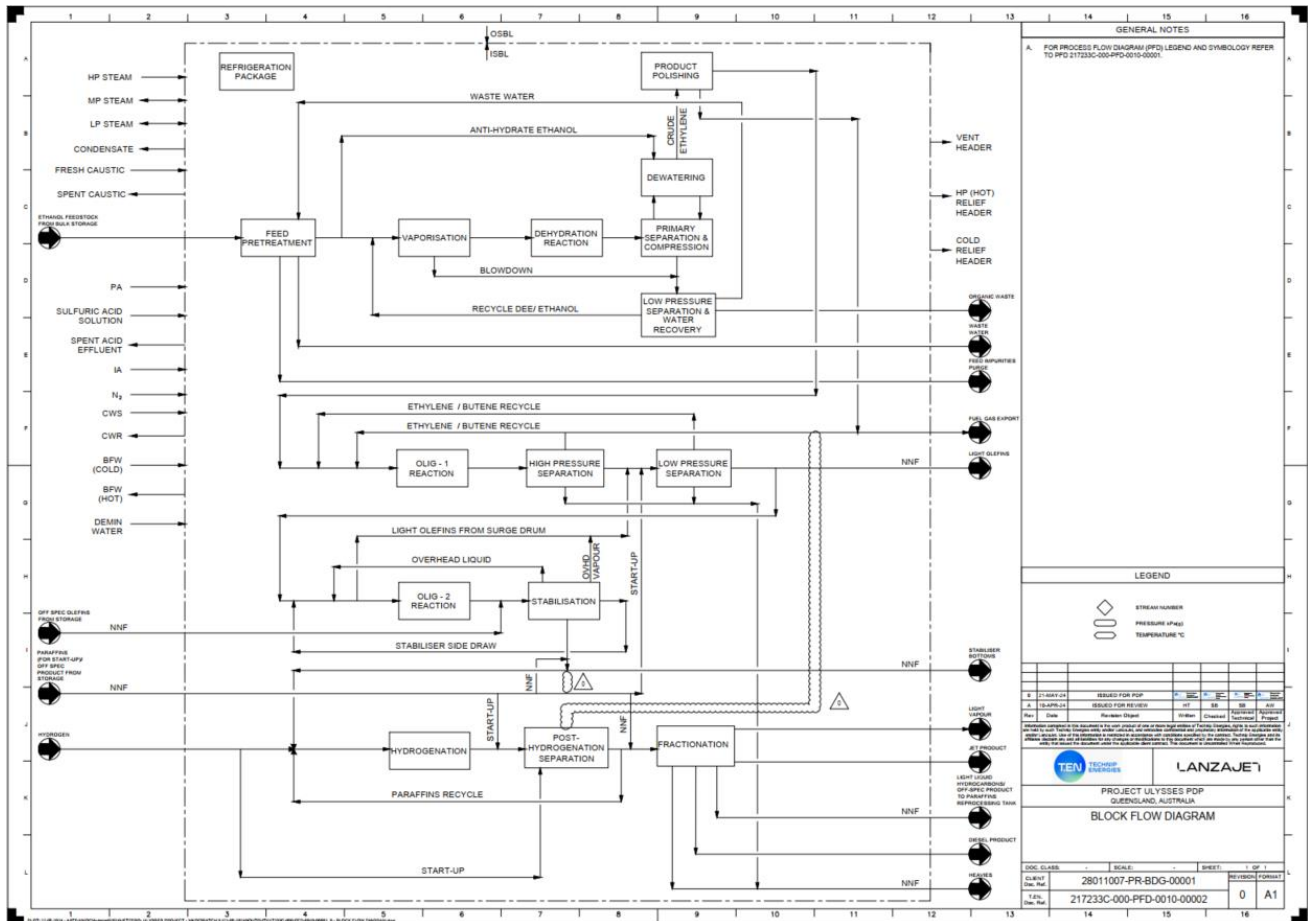


Figure 2-2: Block Flow Diagram

2.3 Proposed Facilities and Infrastructure

The core infrastructure footprint includes the following:

- The facility site,
- Access roads,
- Wastewater pipeline, and
- Water supply pipeline.

The facility will incorporate the following key infrastructure:

- Eastern portion:
 - Laydown area.
- Central portion:
 - Process unit and flare.
 - Utility unit (storage tanks, pumps and boilers).
 - Storage unit (ethanol, paraffin and SAF bulk).
 - Administration unit (laboratory, process control room, warehouse workshop, security gatehouse, administration building and parking area).
 - Industrial and general site entrances from the south.
 - Two emergency exits from the south.
- Western portion:
 - Hydrogen unit and caustic basin.
 - Truck loading unit.
 - Substation and electrical cable trench.
 - Clean wastewater channel.
 - Contaminated water basin.
 - One emergency exist/fire control access (south).

Figure 2-3 shows the current conceptual site plan (dated 15/10/2024).

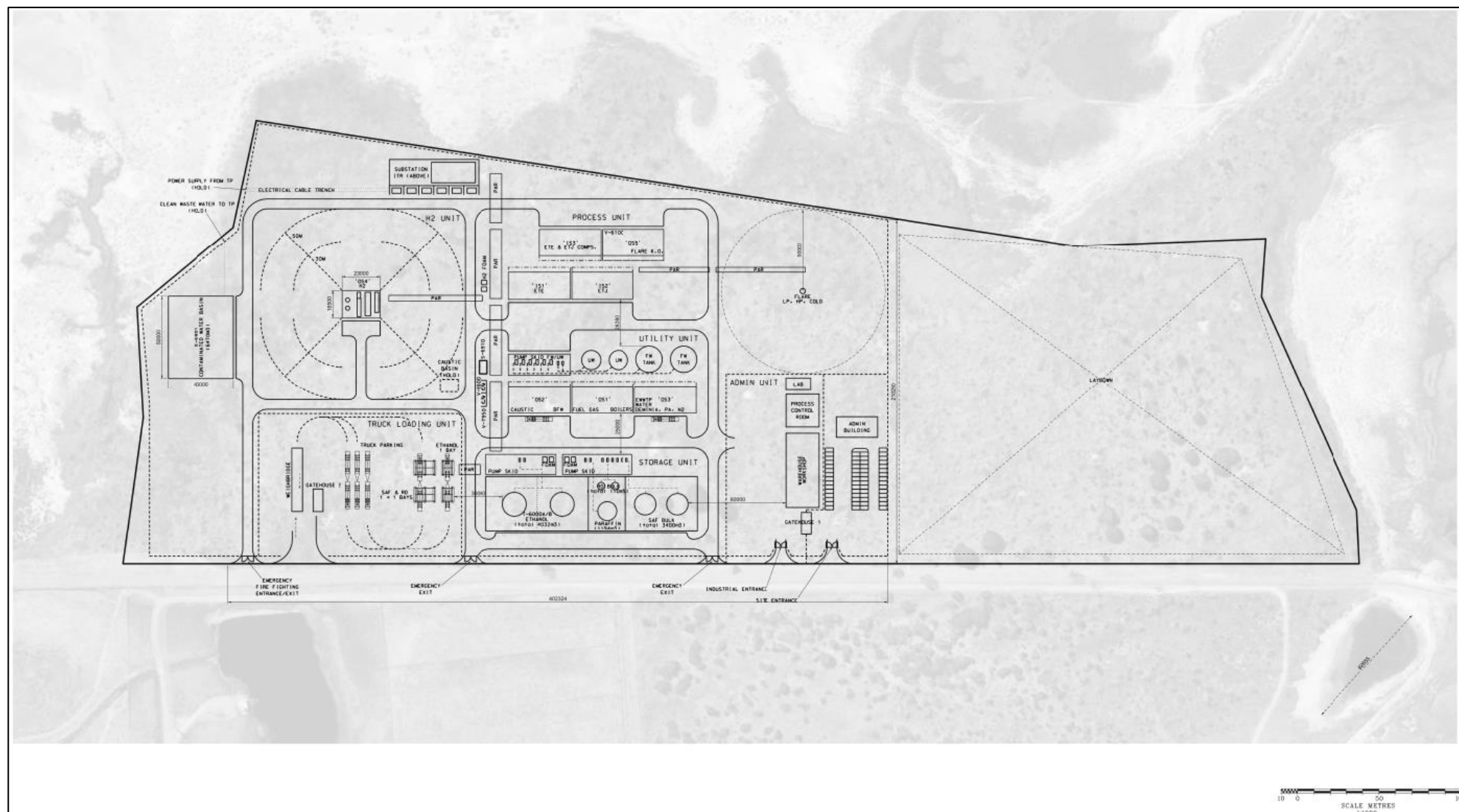


Figure 2-3 - Concept Site Plan Rev 0 (dated 15/10/2024)

2.4 Project Summary

The current Project description summary is outlined in Table 2-1 which provides the key components of the Project.

Table 2-1: Project Description Summary

Project Aspect	Description																								
Plant location	- Street address: 63 and 249E Heleen Downs Road and 46 Colinta Road, Stuart, Townsville (a new address will be assigned by Townsville City Council following plan seal and registration of the new title). - Planning scheme: Lot 35 on SP341877 (Freehold Land) within 'Stage 3 (area 35)' of CBIP - Planning zoning: 'High Impact Industry' and 'Environmental Management' under the Townsville SDA Development Scheme - Developer: Cleveland Bay Industrial Park Pty Ltd																								
Plant feedstock	Ethanol feedstock derived from agricultural byproducts such as waste wheat starch, will be sourced for conversion to SAF and RD. The expectation is that all feedstock will be sourced from an existing Australian ethanol supplier. International import is being secured as a back-up in case of operational issues and contingency.																								
Plant production	- Sustainable Aviation Fuel (SAF): 100 ML per year. - Renewable Diesel (RD): 11 ML per year. - Plant feedstock of 144,700 tonnes / 183 ML of anhydrous ethanol per year.																								
Storage capacity	Storage capacity of feedstock, fuel, gases and dangerous goods on-site, with approximate volumes of: <table> <tr> <th>Volume</th><th>Chemical</th></tr> <tr> <td>9.16 ML</td><td>Ethanol</td></tr> <tr> <td>4.82 ML</td><td>Sustainable aviation fuel</td></tr> <tr> <td>460 KL</td><td>Renewable diesel</td></tr> <tr> <td>0.7 tonnes</td><td>Hydrogen.</td></tr> <tr> <td></td><td></td></tr> <tr> <td>2 TJ/day</td><td>Natural Gas</td></tr> <tr> <td>884 tonnes</td><td>Hydrogenation off-spec fluids</td></tr> <tr> <td>569 tonnes</td><td>Olig off-spec fluids</td></tr> <tr> <td>114 KL</td><td>Caustic tanks</td></tr> <tr> <td>114 KL</td><td>Acid Tank (Sulphuric Acid)</td></tr> <tr> <td>30 KL</td><td>Liquified Nitrogen</td></tr> </table>	Volume	Chemical	9.16 ML	Ethanol	4.82 ML	Sustainable aviation fuel	460 KL	Renewable diesel	0.7 tonnes	Hydrogen.			2 TJ/day	Natural Gas	884 tonnes	Hydrogenation off-spec fluids	569 tonnes	Olig off-spec fluids	114 KL	Caustic tanks	114 KL	Acid Tank (Sulphuric Acid)	30 KL	Liquified Nitrogen
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Logistics	- Ethanol feedstock to plant site: Ethanol product will be received via ship at the Port of Townsville, then transported to site via truck. - SAF product from plant site: SAF product will be transported from site via B-double trucks (to be confirmed) for storage then blending with A1 jet fuel prior to delivery to airlines via established airport fuel infrastructure. - Renewable diesel product from plant site: RD product will either be loaded onto end customers trucks at our site, or it will be transported from site via trucks to customers site storage. - Road transport access road for the site will link from the Southern Port Road (Ron McLean Drive), south of Townsville and north of the Bruce Highway. The access road will link from the existing Southern Port Road at the edge of the CBIP area, and travel east along Heleen Downs Road, then north along Colinta Drive to the southern entrance to the facility site. CBIP plan to construct road access from Colinta Drive to the Project Ulysses facility. - Electricity will be supplied by overhead 66kV line from Ergon's existing southern powerline route - Natural gas may be supplied by pipeline from the Northern Queensland Gas Pipeline lateral to the facility - Hydrogen will be either generated on site using renewable electricity or it will be procured from a third party and either delivered via pipeline or trucked to the plant site.																								
Plant construction and operation	365 days per annum 24 hours per day																								

Plant flare	Flare height is assumed as 50m with HP/LP in the same stack. Other dimensions including area, radius and volumetric flow to be determined (dimensions and design / operation will be based on Pre-FEED Flare Study).
Plant process wastewater	- The plant will be designed for environmental compliance. Wastewater is to be treated at the plant where possible within a Wastewater Treatment Plant (WWTP) or at the Cleveland Bay Wastewater Treatment Plant (CBWWTP) to avoid any licensed discharge to the environment. The definition / description includes: - Process water: wastewater from the facility is to be re-used or recycled within the plant for process water where possible. Wastewater that cannot be re-used or recycled (high Total Dissolved Solids (TDS) from blowdown from cooling water, boilers and water treatment ~ 15 m³/h), may be accepted for treatment by the on-site WWTP or CBWWTP, depending on water quality and volumes. - Sewage effluent / grey water: During operation the wastewater from the office facilities will be stored in a holding tank (size to be determined) and pumped intermittently to CBWWTP down the 75mm trade waste line for treatment and disposal, if there is sufficient capacity for the volume of Equivalent Persons (EP) planned for construction and operations. During construction, the wastewater will be managed with a temporary site wastewater facility managed by the construction contractor
Site stormwater	- The aim of the plant site design for environmental compliance with stormwater is to ensure rainfall and overland flow of soft stand areas (considered uncontaminated) within the plant site boundary are directed to discharge points, and flow to the environment. All stormwater within hardstand areas of the plant site is to be contained and treated onsite at the WWTP or transferred to the CBWWTP, without direct discharge to the environment. The definitions / description includes: - Uncontaminated - clean stormwater from 'undeveloped' soft stand / pervious areas: direct rainfall runoff to grade that is not contaminated. Runoff can be directly to the environment, without treatment required. 28011-ENG-PLA-0001 Rev 1 10 of 54 Project Aspect Description - Potentially contaminated – stormwater from 'developed' hardstand / impervious areas: direct rainfall runoff or overland flow from areas within the plant boundary including roadways, carpark and tank fields that are potentially contaminated will be directed to a closed system including a bioretention base or contaminated water tank and oily water treatment system. Water captured within the tank field can be released to this drainage system following a rainfall event. The 'first flush' (10% of volume) of runoff is to be captured within a bioretention basin or contaminated water tank, treated (ecological process), and tested to meet water quality compliance requirements. The treated water could potentially then be released to the receiving environment, if in compliance or if not, then redirect to the process water or sent to CBWTP for disposal. - Contaminated – stormwater from 'process unit' hardstand impervious areas: direct rainfall runoff with expected contamination from within the process areas, including process water, floor washing, steam condensate, cooling tower and boiler blowdown water, water treatment backwash water, tank washing, water treatment and process sludges. This process wastewater is to be reused as process water, or treated within the plant WWTP or sent to CBWTP for treatment and disposal.
Project Engineering Design Assumptions (related to approvals process)	- Power (electricity) required estimated at 44 MW continuous supply. - Raw water sourced from local Townsville supply to the main located at Colinta Road. - Port of Townsville tank storage for ethanol and SAF Specialist studies as part of FEED will input / inform engineering design such as the Safety Case and Safety Management System (SMS), as part of the HSEQ-MS (including Hazard Identification (HAZID) and Hazard Operability (HAZOP) workshops), geotechnical investigations (including soils testing and analysis), stormwater and erosion control design and management. Other specialist studies conducted will be informed with FEED design parameter to assess air emissions (point sources, velocity, temperature, air quality discharge), noise emissions (point source, dBA levels from equipment), and Greenhouse Gas emissions.

3 Air Pollutants of Concern

The main activities associated with the Project with the potential to lead to air quality impacts if not managed correctly include:

- Construction; and
- Normal or routine operation and non-routine operations including commissioning, start up and emergency or maximum release worst-case flaring.

It is noted that operation of the flare is not proposed as continuous during routine operations and this report therefore considers worst-case conditions that may result during commissioning, start up and emergency or worst-case maximum flaring. The following sections describe the primary sources of air pollutants anticipated to be associated with the construction and operation of the Project. As discussed in section 2.2, a limited amount of detail is known about the design of the Project and various informed assumptions have been made which are further described in section 6.2.

3.1.1 Construction

Dust emissions can occur during the preparation of the land, demolition and during construction itself. The main air pollution and amenity impacts from construction activities are:

- annoyance due to dust deposition (soiling of surfaces) and visible dust;
- elevated concentrations of airborne particulate matter due to dust-generating activities; and
- exhaust emissions from construction equipment.

Very high levels of soiling can also damage plants and affect the diversity of ecosystems.

The construction schedule and associated equipment are not known at this stage. These construction activities are inherently temporary and potential off-site impacts upon air quality (primarily as dust) are typically addressed and controlled based upon a construction management plan. In addition, as described in section 5.1 the closest sensitive receptors are approximately 2.2km from the site boundary such that impacts upon dust levels at these locations are not expected. As noted in the Air quality guidance note for Construction Sites (NSWEPA, 2024), previous studies and common sense suggest that most adverse impacts on air quality surrounding construction sites will occur in the immediate area surrounding those sites. Sometimes significant low level dust emissions may cause problems some hundreds of metres downwind, but this is the exception rather than the rule. Standard industry practice is therefore that construction dust is typically not modelled because it is temporary and difficult to quantify accurately. And given that the distance to the closest sensitive receptors is very large, a quantitative assessment of dust emissions (e.g. using air dispersion modelling) is not reported here.

3.1.2 Operation

The primary Project facilities in relation to potential air quality impacts, consists of the process unit and flare, utility storage tanks, pumps and boiler, and bulk storage unit for ethanol, paraffin and SAF. The key sources of air emissions during Operations include:

- Natural-gas fired boiler emissions
- Flaring of hydrocarbons
- Operational vent releases in the process unit
- Fugitive emissions from hydrocarbon storage, transfer and leak sources.

Potential operational air emissions from the Project operations also include those generated by associated infrastructure such as from vehicles travelling on internal access roads. In addition, air emissions from the operational vent releases and fugitive sources are also minor. As discussed in section 2.1, given the distances to the nearest sensitive receptors (i.e. 2.2km from the nearest residences and 690m from commercial premises), impacts upon air quality from these sources are expected to be negligible and are not quantitatively assessed here.

The key air emissions of concern from the Project are therefore from the combustion of natural gas and by flaring hydrocarbons during routine and non-routine operations. It is noted that operation of the flare is not proposed as continuous during routine operations and non-routine operations include worst-case conditions that may result during commissioning, start up and emergency or worst-case maximum flaring. The key air pollutants of concern include oxides of nitrogen (NO_x) and some non-combusted hydrocarbons or volatile organic compounds (VOCs). There is also potential for traces of particulate matter and sulphur dioxide (SO₂) from the flaring operations. However, these are negligible (USDoE, 2021, 2021a; Georgia DNR, 2022).

Further details regarding the potential processes, facilities, and air emission sources and assumptions in their derivation are provided in section 6.2.

4 Regulatory Framework and Guidance

4.1 Legislation and Policy

In Queensland, the environmental impacts of an activity involving air emissions are regulated under the Environmental Protection Act 1994 (EP Act) and subordinate legislation, including the Environmental Protection Regulation 2019 (EP Regulation) and Environmental Protection (Air) Amendment Policy 2024 (EPP(Air Amendment 2024) which makes amendments to the Environmental Protection (Air) Policy 2019 (EPP Air) and is current from 1 January 2025 to ensure Queensland remains consistent with the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM)..

With regard to air emissions, a contaminant can be (s. 11, EP Act):

- (a) a gas, liquid [such as a mist or vapour] or solid [including particulates, such as dust or smoke]; or
- (b) an odour; or
- (c) an organism (whether alive or dead), including a virus; or
- (d) energy, including heat, radioactivity and electromagnetic radiation; or
- (e) a combination of contaminants.

The EPP(Air) refers to a contaminant as an indicator of the air environment.

The EP Regulation and EPP (Air) provide further information on how an application will be assessed and decided. The EPP (Air) identifies environmental values to be enhanced or protected and specifies air quality objectives for indicators (selected contaminants) to protect these values. These objectives are derived from national and international standards, including the National Environment Protection (Ambient Air Quality) Measure, National Environment Protection (Air Toxics) Measure, World Health Organization Guidelines for Europe (2000) and United States Environmental Protection Agency.

4.2 Guidance Documents

The Department of Environment, Science and Innovation (DESI) Air—EIS information guideline (ESR/2020/5294) and Applications for activities with impacts to air (ESR/2015/1840) advise proponents in relation to air emissions when preparing an environmental impact statement (EIS) and outlines the information to be provided to the department as part of the ERA application process.

In general, there are three key areas to be identified and addressed through the process:

- Identify the environmental values of the receiving air environment including the identification of any nearby sensitive places.
- Identify the possible impacts of the proposed activity and all associated risks to the environmental values.
- Identify the strategies to mitigate the identified risks to the environmental values.

4.3 Relevant Ambient Air Quality Criteria

As discussed in section 4.1, air quality objectives for selected contaminants are specified in the EPP (Air) and objectives defined in the current revision of this policy commencing 1 January 2025 are adopted for comparison with model predictions. In the absence of relevant objectives in the EPP (Air), as recommended by DESI in the guidance documents, air quality criteria for some contaminants are adopted from the NSW Approved Methods 2023 (NSW EPA, 2022), Victorian EPA Guideline for Assessing and Minimising Air Pollution in Victoria 2022 (EPAV, 2022) and Texas Commission on Environmental Quality prescribed standards 2016 (TCEQ, 2016).

The current air quality objectives for pollutants of interest are presented in Table 4-1.

Table 4-1: Relevant Air Quality Objectives

Pollutant	Environmental value	Averaging time	Air quality objective ¹	Source
Carbon monoxide	Health and wellbeing	8 hours	11 mg/m ³	EPP(Air)
PM _{2.5}	Health and wellbeing	24 hours	20 µg/m ³	EPP(Air)
	Health and wellbeing	1 year	7 µg/m ³	EPP(Air)
PM ₁₀	Health and wellbeing	24 hours	50 µg/m ³	EPP(Air)
	Health and wellbeing	1 year	25 µg/m ³	EPP(Air)
Nitrogen dioxide	Health and wellbeing	1 hour	164 µg/m ³	EPP(Air)
	Health and wellbeing	1 year	31 µg/m ³	EPP(Air)
	Health and biodiversity of ecosystems	1 year	33 µg/m ³	EPP(Air)
Sulphur dioxide	Health and wellbeing	1 hour	214 µg/m ³	EPP(Air)
		24 hours	57 µg/m ³	EPP(Air)
	Protecting agriculture	1 year	31 µg/m ³	EPP(Air)
	Health and biodiversity of ecosystems	1 year	21 µg/m ³	EPP(Air)
Acetaldehyde	Odour	1 hour	42 µg/m ³	Approved Methods
Ethanol	Odour	1 hour	2,100 µg/m ³	Approved Methods
Methanol	Odour	1 hour	3,000 µg/m ³	Approved Methods
n-Propanol	Odour	1 hour	41 µg/m ³	Approved Methods

1. Gas concentrations at STP

5 Existing Environment

5.1 Local Setting

The site is currently zoned as High Impact Industry and Environmental Management in accordance with the Townsville SDA Development Scheme and is located in a wetlands/swampy area, with industrial activities nearby. The proposed Project aligns therefore with the zoning classification for the site. Urban communities and residential areas are located at significant distances from the Project approximately 2.5 km to the west and south, a bay is situated 2 km to the northeast, and the city of Townsville is approximately 6 km to the northwest. The locations of the nearest potentially affected sensitive receptor to the Project are shown in Figure 5-1. Considering the significant distances separating the site and the nearest receptors, receptors have been grouped into their associated suburbs/localities:

- Oonoonba. Closest receptors approximately 4.2km from nearest site boundary.
- Cluden. Closest receptors (Big 4 Holiday Park) approximately 2.2km from nearest site boundary.
- Wulguru. Closest receptors approximately 3.5km from nearest site boundary.
- Stuart. Closest receptors approximately 3.0km from nearest site boundary.
- Bowling Green Bay National Park. The park is approximately 7km to the east from the site boundary at the closest point.

The following ecological areas (environmentally sensitive receptors) are also considered within this assessment:

- Wildlife adjacent to the Project site.
- Wildlife within the Stuart Creek Nature Refuge, approximately 2.1km from the nearest site boundary.

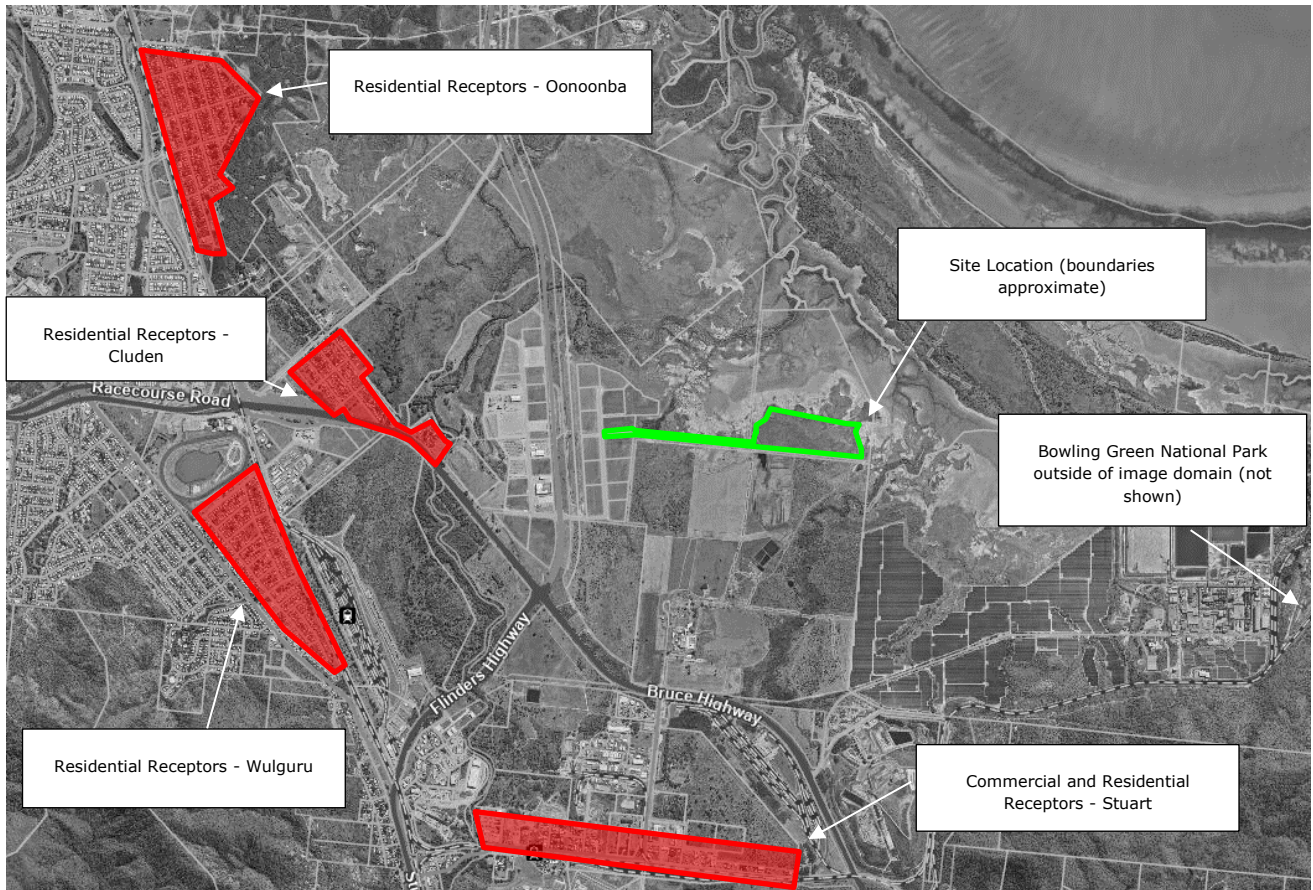


Figure 5-1 - Site Location and Nearest Sensitive Receptors

5.2 Terrain

The terrain surrounding the Project site is predominantly flat with AHD of approximately 1-5m. The terrain data shown in Figure 5-2 captured from NASA's Shuttle Radar Topography Mission (SRTM) at approximately 90m resolution (3-arc seconds).

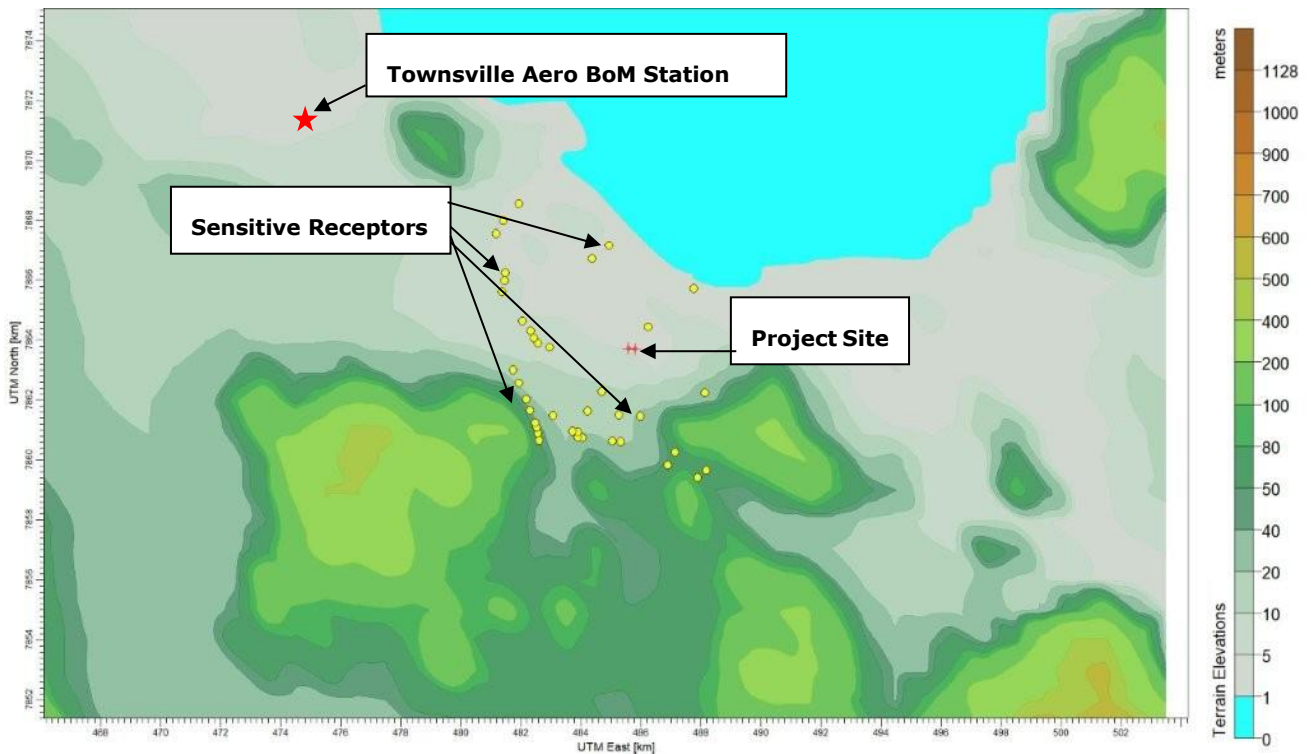


Figure 5-2: Terrain of Surrounding Environment

5.3 Dispersion Meteorology

5.3.1 Regional Meteorology

Data recorded by the nearest Bureau of Meteorology (BoM) long term weather station at Townsville Aero (located approximately 12.4km northwest of the proposed Project site and shown in Figure 5-2) was reviewed to describe the meteorological and climatic influences in the region. Long term weather data obtained from the BOM weather station at Townsville Aero is presented in Table 5-1.

The mean temperature range is between 13.8°C and 31.6°C with the coldest month being July and the hottest, January and December. The rainfall in the region is variable, with most rainfall in the warmer months. On average, most of the annual rainfall is received between January and March. Rainfall is lowest between June and September. The mean annual rainfall is 1131.5 mm.

The long-term wind roses recorded daily at the Townsville Aero station at 9am and 3pm are provided Figure 5-3. Winds are shown to be primarily from the southeast at 9am and northeast directions at 3pm. Stronger winds (>40km/hr or >11.1m/s) occur infrequently mostly from the east at 3pm.

The region experiences a tropical climate, with hot humid summers, warm dry winters with annual wet seasons and pronounced dry seasons in the cooler months.

Table 5-1: Mean Long-term Weather Data for Townsville Aero station

Month	Mean Temperature		Rainfall (mm)	9 am Conditions			3 pm Conditions		
	Max (°C)	Min (°C)		Temp (°C)	RH (%)	Wind Speed (km/h)	Temp (°C)	Mean RH (%)	Wind Speed (km/h)
Jan	31.5	24.4	271.3	28.1	71	10.9	30	65	19.9
Feb	31.2	24.2	301.9	27.6	75	9.7	29.8	67	18.5
Mar	30.8	23.1	188.9	27.2	71	10.2	29.5	63	19.6
Apr	29.7	20.7	66.9	25.6	68	10.7	28.2	60	20.6
May	27.7	17.7	33.9	23	66	8.8	26.3	56	19.4
Jun	25.7	14.8	20.3	20.2	65	8.3	24.4	52	18.1
Jul	25.2	13.8	15.6	19.5	65	7.9	23.8	51	19.9
Aug	26.1	14.8	16.1	21.1	63	10	24.6	52	21.9
Sep	27.9	17.5	10.1	23.9	60	13.7	26.2	53	23.6
Oct	29.5	20.8	23.7	26.2	60	15.7	27.9	55	23.5
Nov	30.8	22.9	60	27.7	63	15.1	29.2	58	23.1
Dec	31.6	24.2	123.5	28.4	66	13.5	30.1	60	22.2
Annual	29	19.9	1131.5	24.9	66	11.2	27.5	58	20.9

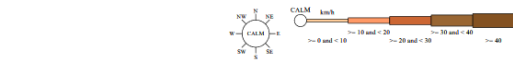
Rose of Wind direction versus Wind speed in km/h (01 Nov 1940 to 10 Aug 2024)

TOWNSVILLE AERO

Site No: 032040 - Opened Jan 1940 - Still Open - Latitude: -19.2483° - Longitude: 148.7661° - Elevation 4.3m

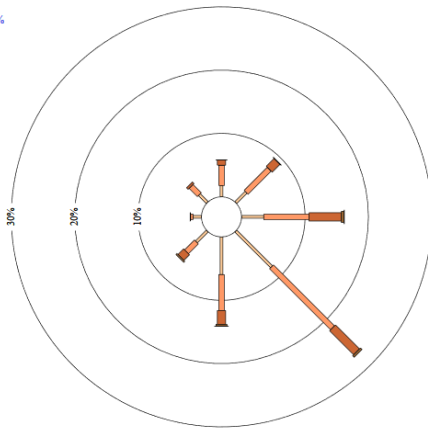
An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.



9 am
30436 Total Observations

Calm 16%



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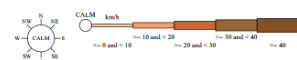
Rose of Wind direction versus Wind speed in km/h (01 Nov 1940 to 10 Aug 2024)

TOWNSVILLE AERO

Site No: 032040 - Opened Jan 1940 - Still Open - Latitude: -19.2483° - Longitude: 148.7661° - Elevation 4.3m

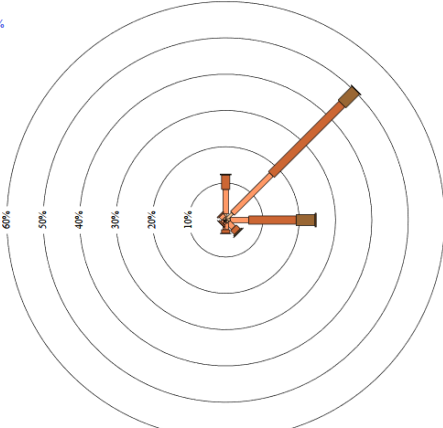
An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.



3 pm
30437 Total Observations

Calm 1%



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Location: Townsville Aero Station

Data Period: 1940 to 2024

Data Type: Measured Data

Figure 5-3: Annual Wind Rose for Townsville Aero Weather Station (1940 to 2024)

5.3.2 Local Meteorology

A three-dimensional meteorological field was required for the air dispersion modelling that includes a wind field generator accounting for slope flows, terrain effects and terrain blocking effects. The Air Pollution Model, or TAPM, is a three-dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research and can be used as a precursor to CALMET which produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables for each hour of the modelling period. The TAPM-CALMET derived dataset for 12 continuous months of hourly data from the year 2023 and approximately centred at the proposed Project site has been used to provide further information on the local meteorological influences. Details of the modelling approach are provided in section 6.3.

5.3.2.1 Wind Speed and Direction

Figure 5-4 presents the annual and seasonal wind roses from the TAPM-CALMET derived dataset for the year 2023 at the proposed Project site location. Wind roses from 9am and 3pm for the derived dataset are also provided in Figure 5-4 for comparison with the long term recorded data from the Townsville Aero Weather Station. Key features of the winds are:

- Winds are predominantly from the southeast with average wind speed of 3.2 m/s;
- Calm winds (<0.5m/s) are infrequent representing only 1.63% of the winds for the year;
- The strongest winds (>5.7m/s) occur mostly from the southeast at 9am and from the east at 3pm;
- Lighter winds (<5.7m/s) primarily from the east and southeast occur in summer and autumn; and
- The 9am and 3pm wind roses for the TAPM-CALMET derived dataset are generally consistent with the measured data from the Townsville Aero BoM Weather Station. Winds are shown to be primarily from the southeast at 9am and northeast and east directions at 3pm.

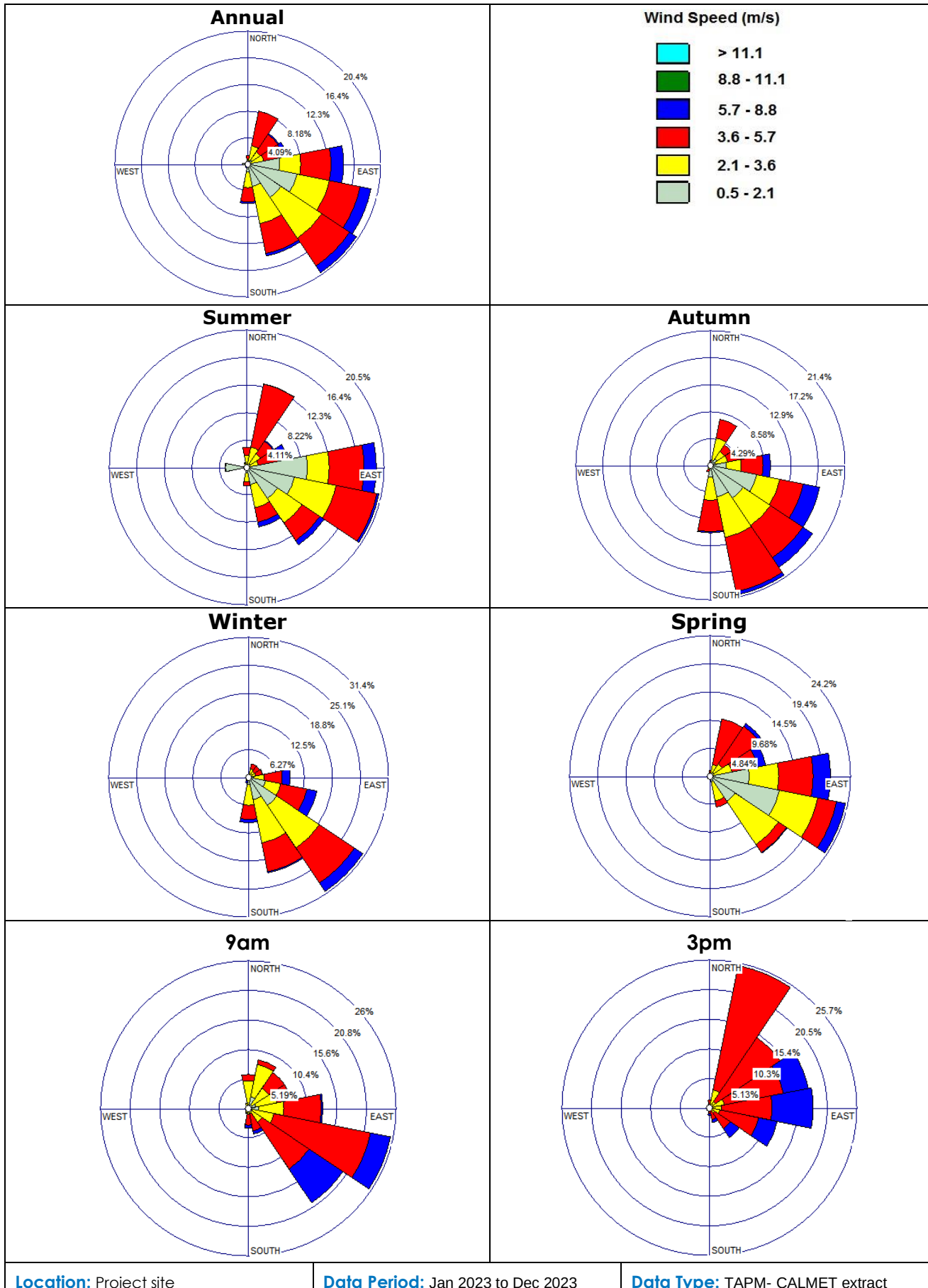


Figure 5-4: Wind Roses for the TAPM-CALMET Derived Dataset at the Project site, 2023

5.3.2.1 Atmospheric Stability

The Pasquill-Gifford stability classification scheme denotes stability classes from A to F. Class A is described as highly unstable and occurs in association with strong surface heating and light winds, leading to intense convective turbulence and much enhanced plume dilution. At the other extreme, class F denotes very stable conditions associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Intermediate stability classes grade from moderately unstable (B), through neutral (D) to slightly stable (E). Whilst classes A and F are strongly associated with clear skies, class D is linked to windy and/or cloudy weather, and short periods around sunset and sunrise when surface heating or cooling is small. Figure 5-5 shows the stability class percentages from the TAPM-CALMET derived meteorological data for the project site. The data identifies that Stability Class D is most common; this stability class is indicative of neutral atmospheric conditions.

As a general rule, unstable (or convective) conditions dominate during the daytime and stable flows are dominant at night. This diurnal pattern is most pronounced when there is relatively little cloud cover and light to moderate winds.

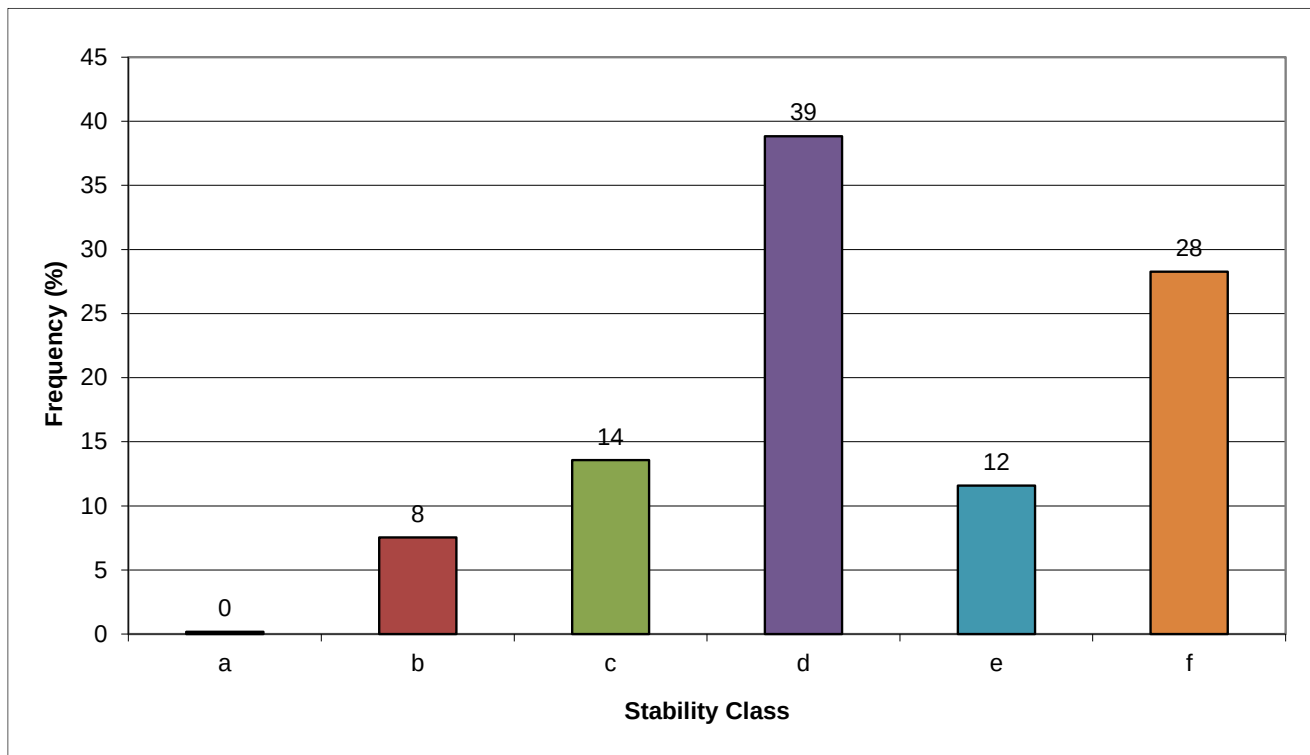


Figure 5-5: Stability Class Percentages for the TAPM-CALMET Derived Data, 2023

5.3.2.2 Mixing Height

The mixing height is the height of vertical mixing of air and gases or particles above the ground. The mixing height is defined as the height of the layer adjacent to the ground over which an emitted or entrained inert non-buoyant tracer will be mixed (by turbulence) within a time scale of about one hour or less. It is an important parameter when assessing air emissions as it defines the vertical mixing of a plume. This is because the air below the layer has restricted dispersion vertically and therefore the higher the mixing height, the more potential for dispersion.

Diurnal variations in mixing depths are illustrated in Figure 5-6. As would be expected, an increase in the mixing depth during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and the growth of the convective mixing layer.

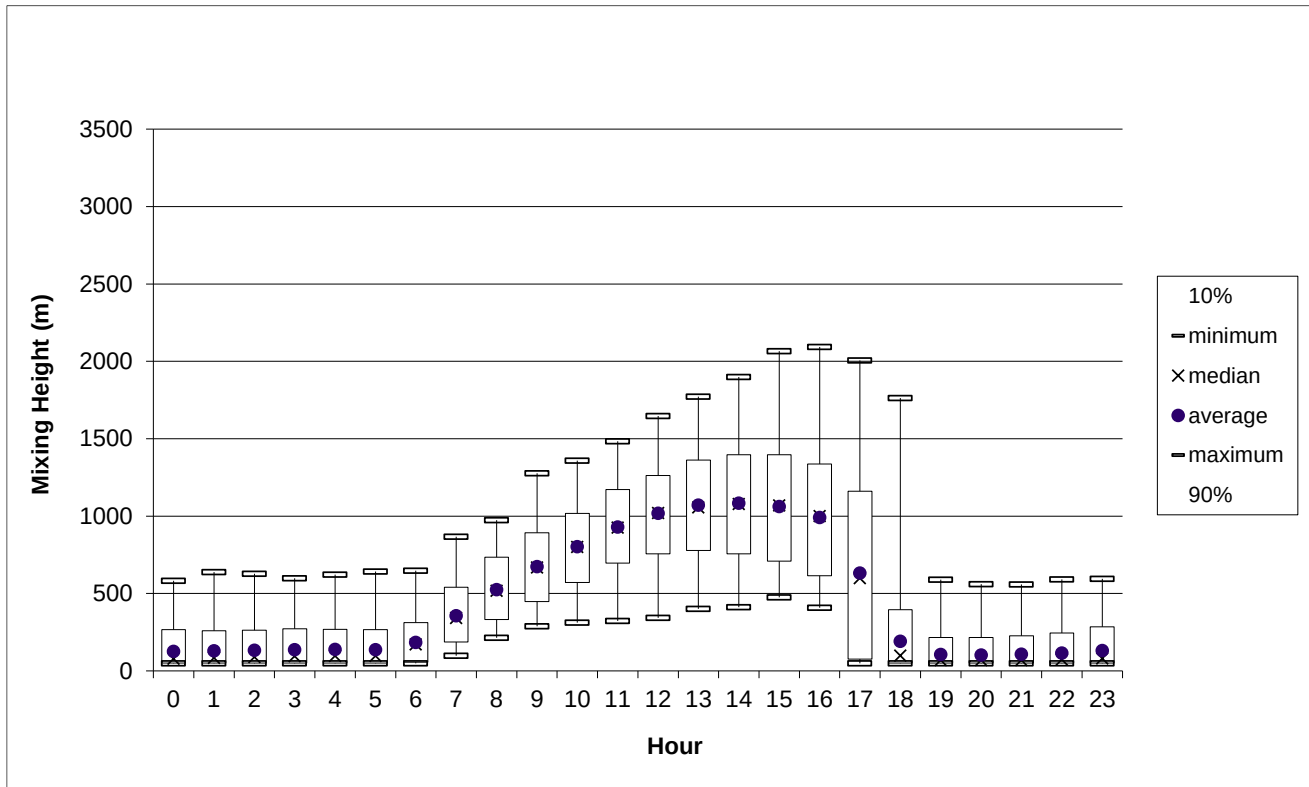


Figure 5-6: Mixing Height of the TAPM-CALMET Derived Data, 2023

5.4 Existing Air Quality

Existing air quality in the region surrounding the site is primarily influenced by exhaust emissions from the local road infrastructure and emissions from industrial and manufacturing sources in the area. In addition, there is potential for dust sources from wind erosion of exposed soil and particulates from bushfire smoke (DESI, 2024).

DESI currently operates four monitoring stations in the Townsville area including Coastguard, Environment Park, Lennon Drive and North Ward. There are also several historical stations that have been closed. The North Ward site was selected for NO₂, PM₁₀ and PM_{2.5}. Carbon Monoxide concentrations are not measured at Townsville, data was sourced from the Boyne Island station for this pollutant. The use of data from these regional stations is consistent with DES (2019). A summary of the highest reported yearly pollutant concentration statistics from 2019 to 2023 from the monitoring sites for inclusion in the dispersion modelling predictions as background concentrations is presented in Table 5-2.

The trends in air quality data across the year are analysed by the various regulatory bodies (e.g. DESI, EPA Victoria) using concentration percentiles for the year for each parameter and station. This approach assesses how pollutant concentrations are distributed across the year and is similar to expressing the data as the Nth highest value. For example, the 95th percentile of daily peak concentrations corresponds to the 18th highest daily peak concentration if there is 100% data availability.

As shown in Table 5-2, maximum reported 24 hour average concentrations of PM₁₀ and PM_{2.5} already exceed the relevant criteria for these pollutants. These exceedances are attributed to exceptional events such as bushfire burning or dust storms and a percentile (rather than maximum concentration) is adopted for estimation of background for short-term average concentrations (e.g. other than annual average). This approach aligns with EPA Victoria which suggests adopting a 70th percentile concentration as an estimate of background. In the absence of reported 70th percentiles for the DESI Air Quality Monitoring data for NO₂, PM₁₀ and PM_{2.5} and CO the highest reported 75th percentile from the five-year period is conservatively adopted, where relevant. Other pollutants including the VOCs that are assessed here are not measured at any of the DESI monitoring stations and given that background levels of these pollutants are expected to be minimal at the project location.

Table 5-2: Ambient Air Quality Background (2019 – 2023)

Measurement Station	Parameter	Period	Highest Statistic	Value (µg/m³)	Ambient Air Quality Criteria (µg/m³)
North Ward	PM ₁₀	24 Hour	75 th percentile	22.1	50
			99 th percentile	79.9	
			Maximum	277.4	
		Annual	Average	20.2	25
	PM _{2.5}	24 Hour	75 th percentile	8.0	25
			99 th percentile	28.3	
			Maximum	51.5	
		Annual	Average	7.0	8
	NO ₂	1 Hour	75 th percentile	16.4	250
			99 th percentile	49.2	
			Maximum	84.1	
		Annual	Average	6.2	62
	SO ₂	1 Hour	75 th percentile	0	214
			99 th percentile	2.9	
			Maximum	14.3	
		24 Hour	75 th percentile	1.1	57
			99 th percentile	2.8	
			Maximum	3.3	
		Annual	Average	0.7	31/21 ^a
	Boyne Island	CO	8 hour	75 th percentile	250
99 th percentile				500	
Maximum				1,000	

- a. SO₂ annual criteria is specified as 31 $\mu\text{g}/\text{m}^3$ for protecting agriculture and 21 $\mu\text{g}/\text{m}^3$ for health and biodiversity of ecosystems

6 Methodology

6.1 Overview

The overall approach to the assessment follows the guidelines outlined in the Air—EIS information guideline (DES, 2022) and Applications for activities with impacts to air (ESR/2015/1840) prepared by DESI and the CALPUFF modelling guidance (NSW OEH, 2011). The assessment was conducted as follows:

- An emissions inventory of the primary air pollutants emitted by the proposed Project for maximum operating scenarios has been developed. Air emission rates required for the modelling assessment are derived, and scaled by a factor of approximately three, based upon data provided for the LanzaJet's commercial-scale 38 ML pa Freedom Pines Fuels Plant (USDoE, 2021, 2021a; Georgia DNR, 2022), internationally recognised emissions estimation techniques (e.g. NPI EET or USEPA AP42 Methodology) and/or Vipac's database of similar projects.
- The emissions data was used as input for air dispersion modelling. The modelling techniques were based on a combination of The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the CALMET model suite used to generate a three-dimensional meteorological dataset for use in the CALPUFF dispersion model.
- The atmospheric dispersion modelling results were assessed by comparison with the assessment criteria described in Section 4.

6.2 Emissions Inventory

6.2.1 Introduction

As outlined in Section 3, impacts upon the identified sensitive receptors from sources associated with construction activities are expected to be minimal and are not assessed. In addition, the operation of the flare is not proposed as continuous during routine operations and this report therefore considers worst-case conditions that may result during commissioning, start up and emergency or worst-case maximum flaring. Since the Project is currently bridging from the Pre-FEED to FEED phase and limited detail regarding the design of the air emission point sources is available. The primary reference plant for Project Ulysses is LanzaJet's commercial-scale 38 ML pa Freedom Pines Fuels Plant, in the United States. Implementing a modular design, Jet Zero's Project Ulysses will scale up production capacity approximately three times from the Freedom Pines Fuels Plant to a total production capacity of 111 ML pa. As a consequence, much of the emissions data required for the assessment of potential air quality impacts has been derived from the Environmental Assessment and permit documentation for the Freedom Pines facility (USDoE, 2021, 2021a; Georgia DNR, 2022) and scaled in accordance with the increased production and loads outlined in the Project Ulysses Flare and Waste Stream Study (Technip Energies, 2024,2024a,2024b). The intent of the reported Flare Load Summary is to provide the maximum relief scenarios to identify the design cases for the ISBL flare header, KO Drums and Flare Radiation Simulations.

Furthermore, the emissions are estimated for the flare and boiler sources which are considered to be the primary sources of air emissions from the Project as is presented in the Environmental Assessment and permit documentation for Freedom Pines (USDoE, 2021, 2021a; Georgia DNR, 2022). As limited detail regarding the design of the Plant equipment is available at this stage, potential fugitive VOC emissions from sources such as equipment leaks, handling and storage are not assessed. However, as outlined in the Freedom Pines documentation, impacts from these sources on the surrounding environment are expected to be minimal (USDoE, 2021, 2021a; Georgia DNR, 2022).

6.2.2 Emissions Scenarios

The emissions scenarios adopted for the assessment are based upon emergency flare relief (or maximum release) scenarios reported for the Project Flare and Waste Stream Study (Technip Energies, 2024,2024a,2024b) as reproduced in the following subsections.

6.2.2.1 Emergencies Classification

Determination of emergency release scenario has been based on previous experience and efforts have been made to identify all major circumstances.

Two or more causes of overpressure are considered unrelated if among them no linkage exists and if the length of time between the successive occurrences of these causes is enough to permit to consider these causes still unrelated.

The simultaneous occurrence of two or more unrelated causes of overpressure (also known as double or multiple jeopardy) is not a basis for design. However, a single failure of one of the trip systems installed to reduce the flare load will be considered.

Causes of overpressure are classified as deriving from operating or from fire contingencies, and as single, multiple or generalised (common) scenario causing the intervention of pressure relieving devices on one or more systems.

The causes that may lead to overpressure condition for Project Ulysses are as outlined in Table 6-1.

Table 6-1: Emergency Scenarios Causing Overpressure

Emergency Scenario	Description
Blocked (Closed) Outlet	Closure of a block valve (or similar) on a gas outlet line of a pressure vessel. Closure of a block valve (or similar) on liquid outline line of a pressure vessel.
Cooling Water Failure	Loss of cooling water in coolers/condensers. Can affect all equipment using cooling water at the same time.
Refrigerant Failure	Loss of refrigerant in condensers. Can affect all equipment using refrigeration at the same time.
Steam Failure	Loss of steam in reboilers, vaporizers etc. Can affect all equipment using steam at the same time.

Reflux Failure	Loss of reflux causes the temperature in the column to rise, leading to vapor build-up and overpressure
Valve/Controller Malfunction /Mis-operation	Examples include inadvertent valve operation and control valve fails fully open. One valve is considered at a time.
Runaway Reaction	An abnormal increase in temperature of reaction causes the rate of reaction to increase, leading to rapid rise in pressure. Relief valves may not provide adequate protection (slow response), depressuring systems are more appropriate.

6.2.2.2 Relief Loads

To evaluate the maximum flare load and to size the flare header, the following general emergency scenarios were considered in the Project Ulysses Flare and Waste Stream Study (Technip Energies, 2024,2024a,2024b):

- Cooling Water Failure (if implemented)
- Total Electric Power Failure
- Refrigerant Failure
- Steam Failure
- Closed Outlet Overfilling
- Fire load (Fire zone)

6.2.2.3 Modelled Emissions Scenarios

The summary of relief load to flare for the various possible scenarios were calculated (Technip Energies, 2024,2024a,2024b) and the maximum relief scenarios have been modelled assessed as follows:

- Scenario 1 - Cooling Water Failure (if implemented)
- Scenario 2 - Total Electric Power Failure
- Scenario 3 - Closed Outlet Overfilling
- Scenario 4 - Start-up

These scenarios are conservatively modelled as continuous emissions despite the expected frequencies of each scenario to be much less of the order of once per year.

In addition, each scenario conservatively assesses the cumulative impacts from the simultaneous operation of the boiler.

Further details on the derivation of the emission estimates for these scenarios are provided in section 6.2.3.

6.2.3 Emission Sources

6.2.3.1 Flares

The purpose of the flare and vent recovery system is to collect and safely dispose of process fluids in upset conditions, thereby ensuring that an upset does not escalate to increase hazard to personnel, plant and equipment. It also ensures minimum impact on the environment.

Where possible, the vent gases from on/off control valves and purge gas will be recovered and therefore mitigating the need for continuous venting to atmosphere.

The flare system consists of:

- Hot HP flare system,
- Cold Flare system,
- LP Flare system,
- Flare gas recovery package.

At this stage, it is assumed that an elevated combined HP/LP flare of 50m height will be placed in the centre of the sterile area (see Figure 2-3).

The current flare design therefore does not propose continuous flaring during normal operations.

Table 6-2: Maximum Flare Load Relief Scenarios

Parameter	Scenario 1 - Cooling Water Failure	Scenario 2 - Total Electric Power Failure	Scenario 3 - Closed Outlet Overfilling	Scenario 4 - Start-up
Maximum Flare Load (kg/hr)	104,034	47,318	32,813	20,291
Frequency (per year)	<1	<1	12	12
Duration (hours per year)	0.25	0.25	0.5	24
Lower Heating Value (Btu/lb)	16,400	16,400	20,461	10,230

Emissions from vent streams of the main production sections are primarily controlled by the LP and HP/Cold flare. The flare emissions estimates are derived based upon the methodology adopted for the LanzaJet Freedom Pines facility (USDoE, 2021, 2021a; Georgia DNR, 2022). LanzaJet reviewed potential scenarios that would require flaring (such as emergency flaring), including total power failure (emergency), start-ups, valve vents, guard bed regenerations, and continuous vents. For each scenario, LanzaJet conservatively projected the potential duration and frequency of each event. After identifying the mass flow rate, lower heating value, and supplemental natural gas (if required). For each scenario, LanzaJet used criteria pollutant emission factors from Tables 13.5-1 and 13.5-2 of AP-42 Section 13.5, Industrial Flares, to calculate potential emissions of VOC, NOX, and CO from flaring.

For speciated VOC emissions, LanzaJet first estimated the stream composition and VOC content for each potential flaring scenario based on best available engineering estimate and the proposed Heat and Material Balance for the LanzaJet Facility. For each speciated VOC (i.e. Acetaldehyde, Ethanol, Diethyl Ether, Isopropanol, Methanol and Propanol), LanzaJet used the stream composition and VOC emission factor from Table 13.5-2 of AP-42 Section 13.5, Industrial Flares, and normalized emissions of each speciated substance to the VOC content of each of the potential flared streams.

Table 6-3 summarises the derived flare stack modelling input data.

6.2.3.2 Boiler

The 72.7 MMBtu/hr boiler will primarily fire natural gas along with smaller amounts of certain vapor and liquid fuel streams from the process. The boiler will emit PM, PM10, PM2.5, NOx, CO, VOCs to the atmosphere.

Emission factors from AP-42 Section 1.4 and manufacturer specifications (Cleaver-Brooks) were used to calculate emissions from the BL-01 boiler. The boiler will fire primarily natural gas with vapor and liquid fuel streams from the process that are introduced into the flame zone. The boiler is equipped with low NOX burners and flue-gas recirculation. The Division used the "Small Boiler Uncontrolled" emission factors in Tables 1.4-1 and 1.4-2 to calculate emissions from a boiler rated at 72.7 MMBtu/hr.

The pollutant emission rates derived for the LanzaJet Freedom Pines facility have been multiplied by approximately three to allow for increased production associated with the proposed Project.

Table 6-3 summarises the derived boiler stack modelling input data.

6.2.4 Model Input Data

The modelled stack parameters and pollutant emission rates for the flare and boiler are outlined in

Table 6-3. It is noted that flares operate with an exposed flame, extending beyond the stack exit and thus differ from typical point source behaviour. Instead to model their dispersion accurately, equivalent stack heights and flare diameters are based upon formulae provided in the *Air Dispersion Modeling Guidelines for Oklahoma Air Permits, 2017*. As noted in

Table 6-3, the calculated equivalent flare height and diameter using the formulae are 69m and 6m, respectively. These parameters were adopted as input for the CALPUFF modelling.

Table 6-3: Flare and Boiler Stack Parameters

Source	Stack height (m)	Stack diameter (m)	Temperature (K)	Scenario	Pollutant emission rate (kg/hr)			
					CO	NOx	VOCs	PM10 & PM2.5 ^c
Flare	50 ^a	6 ^b	1,273	1	694	128	263	0
				2	316	58.1	120	0
				3	273	50.2	103	0
				4	84.5	15.5	32.0	0
Boiler	20	2	473	All	15	26.1	1.5	4.1

- Modelled as calculated equivalent flare height of 69m based upon formulae provided in the Air Dispersion Modelling Guidelines for Oklahoma Air Permits, 2017
- Calculated equivalent flare diameter in accordance with the Air Dispersion Modelling Guidelines for Oklahoma Air Permits, 2017.
- Emission rates derived for total PM is conservatively assumed as PM10 and PM2.5.

6.3 Modelling

6.3.1 Overview

The modelling approach discussed in the following sections is based on a combination of The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the CALMET model suite used to generate a three-dimensional meteorological dataset for use in the CALPUFF dispersion model. The approach aligns with the guidelines outlined in the Air—EIS information guideline (DES, 2022) and Applications for activities with impacts to air (ESR/2015/1840) prepared by DESI and the CALPUFF modelling guidance (NSW OEH, 2011).

6.3.2 TAPM

A 3-dimensional dispersion wind field model, CALPUFF, has been used to simulate the impacts from the Project. CALPUFF is an advanced non-steady-state meteorological and air quality modelling system developed and distributed by Earth Tech, Inc. The model has been approved for use in the 'Guideline on Air Quality Models' (NSW OEH, 2011) as a preferred model for assessing applications involving complex meteorological conditions such as calm conditions.

To generate the broad scale meteorological inputs to run CALPUFF, this study has used the model The Air Pollution Model (TAPM), which is a 3-dimensional prognostic model developed and verified for air pollution studies by the CSIRO.

6.3.3 CALMET

CALMET is an advanced non-steady-state diagnostic three-dimensional meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system.

The CALMET simulation was run as No-Obs simulation (NSW OEH, 2011) with the gridded TAPM three-dimensional wind field data from the innermost grid. CALMET then adjusts the prognostic data for the kinematic effects of terrain, slope flows, blocking effects and three-dimensional divergence minimisation.

6.3.4 CALPUFF

CALPUFF is a non-steady-state Lagrangian Gaussian puff model. CALPUFF employs the three-dimensional meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal.

Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

Due to the limited change in topography as discussed in Section 5.2, the radius of influence of terrain features was set at 10 km while the minimum radius of influence was set as 0.1 km. The terrain data incorporated into the model had a resolution of 1 arc-second (approximately 30 m) in accordance with the *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'* (NSW OEH, 2011).

The TAPM, CALMET and CALPUFF settings adopted for the modelling are summarised in Table 6-4.

Table 6-4: TAPM, CALMET and CALPUFF settings

Model	Parameter	Setting
TAPM (v4.0.5)	Number of grids (spacing)	30km, 10km, 3km, 1km
	Number of grid points	41 x 41 x 25 (vertical)
	Year of analysis	2023
	Centre of analysis	19° 19.0 S, 149° 51.5 E
	Meteorological data assimilation	DESI Lennon
CALMET (v.6.5.0)	Outer met grid domain	39km x 39km
	Outer met grid resolution	1km
	Outer met grid south-west corner	465km E, 7844.5KM S
	Inner met grid domain	10km x 10km
	Inner met grid resolution	0.1km
	Inner met grid south-west corner	480.66km E, 7858.716km S
	3D Windfield	m3D from TAPM (1 km) input as in initial guess in CALMET
CALPUFF (v6.42)	Method used to compute dispersion coefficients	2 - dispersion coefficients using micrometeorological variables
	Building downwash included	Prime method
	Default settings	All other CALPUFF defaults have been used in line with OEH (2011).

6.4 Other Parameters

6.4.1.1 Modelled Sensitive Receptors

DESI (ESR/2015/1840) describes a sensitive place as, but not limited to:

- a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises
- a motel, hotel or hostel
- a kindergarten, school, university or other educational institution
- a medical centre or hospital
- a protected area under the Nature Conservation Act 1992, the Marine Parks Act 2004 or a World Heritage Area
- a public park or garden
- a place used as a workplace including an office for business or commercial purposes.

A total of 41 sensitive receptors have been identified for this assessment including seven commercial receptors such as Cluden which are approximately 690m from nearest site boundary and two ecological receptors for assessment of impacts

upon biodiversity and ecosystems, and one national park. Figure 6-1 Shows the locations and provides the UTM coordinates of the modelled sensitive receptors.

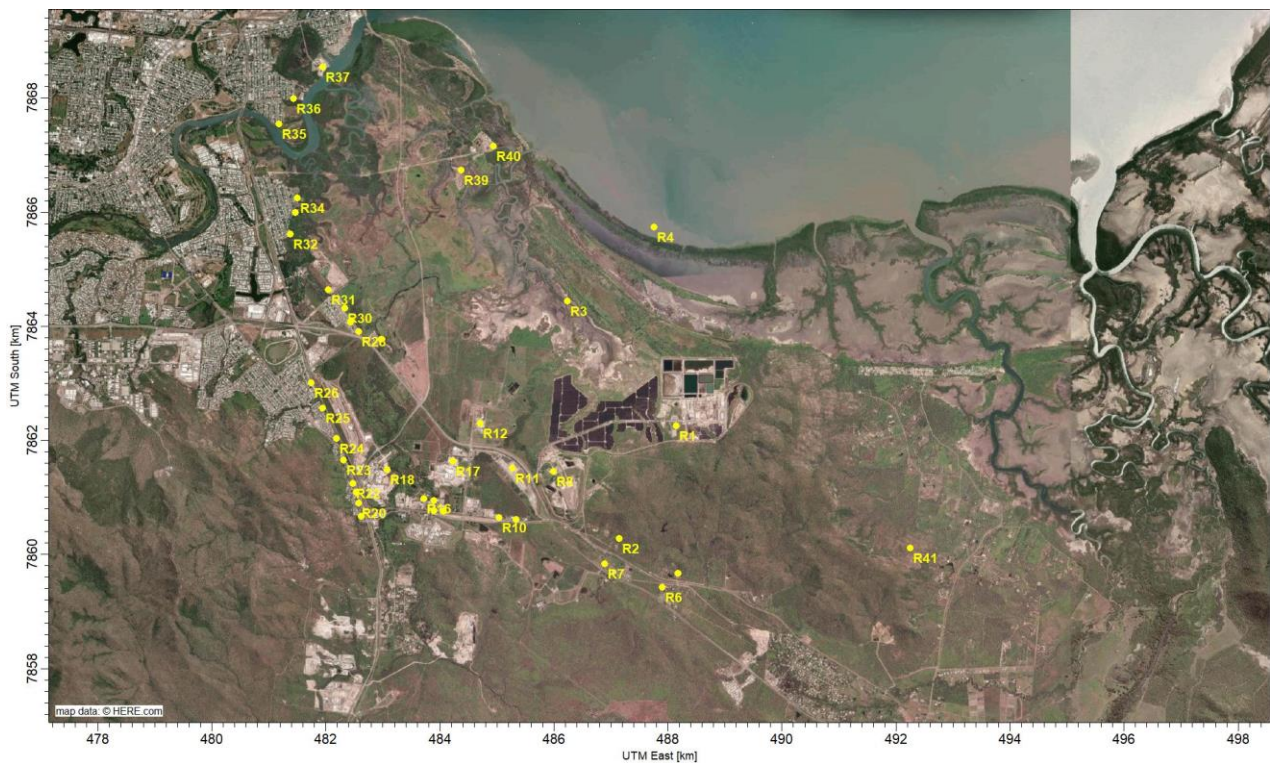


Figure 6-1: Modelled Sensitive Receptor Locations

Table 6-5: UTM Coordinates of the Modelled Sensitive Receptors

ID	UTM Easting (m)	UTM Northing (m)	Description	ID	UTM Easting (m)	UTM Northing (m)	Description
R1	488141	7862254	commercial	R21	482528	7861090	residential
R2	487142	7860281	residential	R22	482475	7861250	residential
R3	486239	7864441	ecological	R23	482305	7861656	residential
R4	487759	7865736	ecological	R24	482190	7862035	residential
R5	488175	7859671	residential	R25	481938	7862565	residential
R6	487894	7859430	residential	R26	481746	7863013	residential
R7	486888	7859837	residential	R27	482969	7863779	residential
R8	485988	7861457	commercial	R28	482576	7863905	residential
R9	485337	7860619	residential	R29	482433	7864075	residential
R10	485040	7860648	residential	R30	482326	7864321	residential
R11	485272	7861508	commercial	R31	482044	7864636	residential
R12	484708	7862299	commercial	R32	481373	7865620	residential
R13	484056	7860758	residential	R33	481461	7865994	residential
R14	483895	7860775	residential	R34	481495	7866252	residential
R15	483895	7860948	residential	R35	481179	7867551	residential
R16	483718	7860977	residential	R36	481426	7867997	residential

ID	UTM Easting (m)	UTM Northing (m)	Description	ID	UTM Easting (m)	UTM Northing (m)	Description
R17	484224	7861637	commercial	R37	481937	7868552	commercial
R18	483070	7861490	commercial	R38	482177	7868993	residential
R19	482621	7860665	residential	R39	484366	7866734	commercial
R20	482569	7860899	residential	R40	484936	7867157	commercial
				R41	492248	7860120	park

6.5 Conversions

6.5.1.1 NO_x to NO₂

Oxides of nitrogen (NO_x) emitted from combustion sources are primarily composed of nitric oxide (NO) and nitrogen dioxide (NO₂).

Eventually, all NO emitted is oxidized to NO₂ in the atmosphere in the presence of ozone and sunlight. This formation of NO₂ from NO is a complex photochemical process depending on factors that include the total amount of available NO_x and ozone. The reaction takes place over several hours and can result in increased ground-level NO₂ concentrations further down-plume (far-field) and decreased closer to the source (near field).

As recommended by the NSW Approved Methods (NSW EPA, 2022) a Level 1 Assessment which is noted as the simplest but most conservative and assumes a 100% conversion of NO to NO₂ with the maximum prediction and maximum background concentrations has been adopted here.

7 Results

7.1 Overview

This section presents the results of the air dispersion modelling for the maximum worst case operation in isolation (i.e. without background) and inclusive of background (i.e. for assessment of cumulative impacts) from the DESI air quality monitoring stations as described in section 5.4. The tabulated results are presented for the cumulative model predictions at all of the modelled sensitive receptors for each pollutant and compared with relevant ambient air quality criteria in Appendix A.

Contour plots showing the spatial distribution of model predictions inclusive of background in the surrounding environment for the Scenario with the maximum predicted ground level concentrations of pollutants (i.e. Scenario 1) are shown in Appendix B.

7.2 Results

7.2.1 Scenario 1

The model predictions including background at the most affected receptors at the Project site for the maximum simultaneous operation of the flare Scenario 1 representing cooling water failure and boiler for one full year are shown in Table 7-1. The table shows that the predicted concentrations of all of the pollutants modelled are below the criteria at all of the modelled sensitive receptors (e.g. residential, commercial and ecological) for Scenario 1.

The contour plots for Scenario 1 are presented inclusive of background in Appendix B. As shown in the contour plots, concentrations of pollutants for longer term averages (e.g. 24 hour PM_{2.5} and PM₁₀ and annual NO₂, PM_{2.5} and PM₁₀) are predicted primarily to the west of the Project and for shorter term averages (e.g. 1 hour NO₂ and TVOCs and 8 hour CO), the predictions are in all directions. This likely demonstrates the impact of the prevailing winds over the longer term (see Figure 5-3) which are from the east and carry the air emissions to the west.

Table 7-1: Model Predictions at the Most Affected Receptors for Scenario 1

Pollutant	Averaging period	Type	Model prediction (µg/m ³)		Criteria (µg/m ³)	Compliant
			Without background	With background		
PM ₁₀	24 hour	Residential	1.62	23.7	50	✓
	Annual	Residential	0.10	20.3	25	✓
PM _{2.5}	24 hour	Residential	1.62	9.62	20	✓
	Annual	Residential	0.10	6.30	7	✓
CO	8 hour	Residential	309	559	11,000	✓
NO ₂	1 hour	Residential	86.8	103	164	✓
	Annual	Commercial	1.24	7.44	31	✓
	Annual	Ecological	0.03	6.23	33	✓
Acetaldehyde	1 hour	Residential	0.12	0.12	42	✓
Ethanol	1 hour	Residential	15.1	15.1	2,100	✓
Methanol	1 hour	Residential	0.07	0.07	3,000	✓
n-Propanol	1 hour	Residential	0.11	0.11	41	✓

7.2.2 Scenario 2

The model predictions including background at the most affected receptors at the Project site for the maximum simultaneous operation of the flare Scenario 2 representing total electrical failure and boiler for one full year are shown in Table 7-2. The table shows that the predicted concentrations of all of the pollutants modelled are below the criteria at all of the modelled sensitive receptors (e.g. residential, commercial and ecological) for Scenario 2.

Table 7-2: Model Predictions at the Most Affected Receptors for Scenario 2

Pollutant	Averaging period	Type	Model prediction ($\mu\text{g}/\text{m}^3$)		Criteria ($\mu\text{g}/\text{m}^3$)	Compliant
			Without background	With background		
PM10	24 hour	Residential	1.62	23.7	50	✓
	Annual	Residential	0.10	20.3	25	✓
PM2.5	24 hour	Residential	1.62	9.62	20	✓
	Annual	Residential	0.10	6.30	7	✓
CO	8 hour	Residential	141	391	11,000	✓
NO ₂	1 hour	Residential	58.1	74.5	164	✓
	Annual	Commercial	0.86	7.06	31	✓
	Annual	Ecological	0.02	6.22	33	✓
Acetaldehyde	1 hour	Residential	0.06	0.06	42	✓
Ethanol	1 hour	Residential	6.87	6.87	2,100	✓
Methanol	1 hour	Residential	0.03	0.03	3,000	✓
n-Propanol	1 hour	Residential	0.05	0.05	41	✓

7.2.3 Scenario 3

The model predictions including background at the most affected receptors at the Project site for the maximum simultaneous operation of the flare Scenario 3 representing closed outlet overfilling and boiler for one full year are shown in Table 7-3. The table shows that the predicted concentrations of all of the pollutants modelled are below the criteria at all of the modelled sensitive receptors (e.g. residential, commercial and ecological) for Scenario 3.

Table 7-3: Model Predictions at the Most Affected Receptors for Scenario 3

Pollutant	Averaging period	Type	Model prediction ($\mu\text{g}/\text{m}^3$)		Criteria ($\mu\text{g}/\text{m}^3$)	Compliant
			Without background	With background		
PM10	24 hour	Residential	1.62	23.7	50	✓
	Annual	Residential	0.10	20.3	25	✓
PM2.5	24 hour	Residential	1.62	9.62	20	✓
	Annual	Residential	0.10	6.30	7	✓
CO	8 hour	Residential	122	372	11,000	✓
NO ₂	1 hour	Residential	58.1	74.5	164	✓
	Annual	Commercial	0.81	7.01	31	✓
	Annual	Ecological	0.02	6.22	33	✓
Acetaldehyde	1 hour	Residential	0.05	0.05	42	✓
Ethanol	1 hour	Residential	5.92	5.92	2,100	✓
Methanol	1 hour	Residential	0.03	0.03	3,000	✓
n-Propanol	1 hour	Residential	0.04	0.04	41	✓

7.2.4 Scenario 4

The model predictions including background at the most affected receptors at the Project site for the maximum simultaneous operation of the flare Scenario 4 representing start-up and boiler for one full year are shown in Table 7-4. The table shows that the predicted concentrations of all of the pollutants modelled are below the criteria at all of the modelled sensitive receptors (e.g. residential, commercial and ecological) for Scenario 4.

Table 7-4: Model Predictions at the Most Affected Receptors for Scenario 4

Pollutant	Averaging period	Type	Model prediction ($\mu\text{g}/\text{m}^3$)		Criteria ($\mu\text{g}/\text{m}^3$)	Compliant
			Without background	With background		
PM ₁₀	24 hour	Residential	1.62	23.7	50	✓
	Annual	Residential	0.10	20.3	25	✓
PM _{2.5}	24 hour	Residential	1.62	9.62	20	✓
	Annual	Residential	0.10	6.30	7	✓
CO	8 hour	Residential	37.8	288	11,000	✓
NO ₂	1 hour	Residential	58.1	74.5	164	✓
	Annual	Residential	0.68	6.98	31	✓
	Annual	Ecological	0.02	6.22	33	✓
Acetaldehyde	1 hour	Residential	0.02	0.02	42	✓
Ethanol	1 hour	Residential	1.83	1.83	2,100	✓
Methanol	1 hour	Residential	0.01	0.01	3,000	✓
n-Propanol	1 hour	Residential	0.01	0.01	41	✓

8 Recommendations

8.1 Construction

As outlined in section 3.1.1, distances of the sensitive (e.g. residential, commercial and ecological) receptors from the construction activities are anticipated to be large enough such that dust emissions will not be carried to them and impacts on air quality from them are expected to be meet relevant criteria at the receptors.

The construction activities are inherently temporary and potential off-site impacts upon air quality are typically addressed and controlled based upon a construction management plan.

Whilst impacts from construction activities are expected to meet criteria, given the size and sensitivity of the project, the proposed mitigation measures include a range of best practice measures specific to the site (e.g. monitoring) which are provided below.

8.1.1 General

Preparation of air quality management measures within a broader Environmental Management Plan (EMP) that considers the adopted assessment criteria, sensitive receptors and the following:

- Detailed construction methodology, including timing and scheduling of relevant work packages.
- Adopted mitigation and management measures specific to each work package.
- Consideration of the nearest receptors during planning/timing of construction works.
- Prior to commencement of construction activities, develop appropriate communications to notify the potentially impacted residences of the project (duration, types of works, etc), relevant contact details for environmental complaints reporting;
- A complaints logbook will be maintained throughout the construction phase which should include any complaints related to dust; where a dust complaint is received, the response actions should be detailed in the logbook;
- Record any exceptional incidents that cause dust and/or air emissions, either on or off site, and the action taken to resolve the situation in the logbook;
- Carry out daily site inspections, including local meteorological forecast. Record inspection results in a logbook;
- Ensure proper maintenance of all equipment engines.

Sampling by dust deposition gauge is recommended during construction, with its results to be compared to the relevant criteria. If deposition rates are above the dust deposition rate criteria of 120 milligrams per square metre per day (ESR/2015/1840) an investigation should be performed to determine:

- whether the concentrations were impacted by other events, i.e. bushfires, dust storms.
- from normal or abnormal operations or
- from operations which require more controls.

8.1.2 Earthworks

- Keep site fencing and barriers clean using wet methods;
- Deploy a water cart to ensure that exposed areas and topsoils/subsoil are kept moist, where necessary;
- Modify working practices by limiting activity during periods of adverse weather (hot, dry and windy conditions) and when dust is seen leaving the site;
- Limit the extent of clearing of vegetation and topsoil to the designated footprint required for construction and appropriate staging of any clearing; and
- Minimise drop heights from loading or handling equipment.
- Revegetate (e.g. landscaping) or seal exposed areas where practicable
- Regular cleaning of work areas and maintain a high level of housekeeping to – especially when waste/spoil is temporarily being stockpiled on site, to minimize the likelihood of windborne dust.

8.1.3 Meteorology and Receptor Location

Stronger winds have a higher potential to generate wind borne dust, particularly during construction processes and material stockpiling. Construction dust emission controls should consider these factors and should be implemented accordingly to ensure protection of the receptors.

8.2 Operational

The modelling assessment of air quality impacts from the operational sources has predicted no exceedances of the relevant criteria for these pollutants at the sensitive receptors.

It is noted, however, that the assessment has been based upon a variety of informed assumptions and the site plan provided. In the event that these assumptions or the site plan are required to differ from those used, then further assessment should be undertaken.

Whilst impacts from operational activities are predicted to meet criteria, given the size and sensitivity of the project, it is recommended that a stack emissions testing program of stack sources (including, for example, stack flowrates, velocities, pollutant concentrations, temperature, pressure) is established upon commissioning and at regular intervals (i.e. annually) for verification of modelled parameters.

9 Conclusions

This document outlines an air quality assessment of the Ulysses Project, being developed by Jet Zero Australia Pty Ltd (Jet Zero). Jet Zero are proposing to construct Australia's first Alcohol-To-Jet (ATJ) plant converting ethanol feedstock into Sustainable Aviation Fuel (SAF) at Townsville, Queensland. The assessment is based on information and data available for the current pre-FEED engineering design phase intended to assist project execution and reduce risk.

The emissions scenarios adopted for the assessment are based upon emergency flare relief (or maximum release) scenarios reported for the Project Flare and Waste Stream Study as follows:

- Scenario 1 - Cooling Water Failure (if implemented)
- Scenario 2 - Total Electric Power Failure
- Scenario 3 - Closed Outlet Overfilling
- Scenario 4 - Start-up

In addition, the emissions scenarios incorporate continuous operation of a natural-gas fired boiler.

The results of the modelling assessment may be summarised as follows:

- the predicted concentrations of all of the pollutants modelled are below the criteria at all of the modelled sensitive receptors (e.g. residential) for all scenarios. The model predictions are also below the criteria at all of the modelled sensitive receptors (e.g. residential, commercial and ecological) for all scenarios.

Furthermore, the modelled scenarios represent worst-case emergency release events which are expected to be infrequent and of short duration.

Overall, based upon the Project design information provided, the modelling results indicate that the operation of the Project will not adversely impact the amenity of any sensitive receptors. In addition, distances of the sensitive (e.g. residential, commercial and ecological) receptors from the construction activities are anticipated to be large enough such that impacts on air quality from them are expected to be meet relevant criteria at the receptors.

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Appendix A Tabulated Sensitive Receptor Results

A.1 Predicted Cumulative Concentrations - Scenario 1

ID	Predicted Cumulative Concentration ($\mu\text{g}/\text{m}^3$)							
	CO	NO ₂		TVOC	PM10		PM2.5	
	8 hour	1 hour	Annual	Annual	24 hour	Annual	24 hour	Annual
R1	383.22	58.23	6.25	75.72	22.31	20.20	8.21	6.20
R2	341.44	45.66	6.41	51.99	22.43	20.21	8.33	6.21
R3	349.49	47.04	6.23	56.65	22.33	20.20	8.23	6.20
R4	342.64	43.21	6.22	53.06	22.21	20.20	8.11	6.20
R5	318.10	35.46	6.31	39.11	22.42	20.20	8.32	6.20
R6	326.56	37.95	6.32	43.95	22.40	20.20	8.30	6.20
R7	342.74	43.09	6.44	53.25	22.31	20.21	8.21	6.21
R8	402.19	65.42	6.69	87.40	22.49	20.22	8.39	6.22
R9	444.91	77.26	6.83	110.84	22.81	20.23	8.71	6.23
R10	559.35	103.23	6.89	177.63	22.78	20.24	8.68	6.24
R11	519.94	100.70	6.97	153.49	22.68	20.24	8.58	6.24
R12	393.69	63.52	7.44	81.53	22.85	20.28	8.75	6.28
R13	500.68	86.67	7.05	143.96	22.65	20.24	8.55	6.24
R14	393.06	57.26	7.06	82.14	22.84	20.24	8.74	6.24
R15	378.87	64.43	7.09	73.71	22.95	20.24	8.85	6.24
R16	380.64	68.47	7.11	73.58	23.14	20.25	9.04	6.25
R17	406.18	66.22	7.26	89.05	22.56	20.25	8.46	6.25
R18	388.53	64.70	7.05	79.57	22.66	20.25	8.56	6.25
R19	382.56	54.79	7.01	76.14	22.50	20.24	8.40	6.24
R20	377.60	59.38	7.05	72.80	22.77	20.25	8.67	6.25
R21	377.42	60.39	7.08	71.72	22.81	20.25	8.71	6.25
R22	373.58	57.75	7.08	69.79	22.70	20.25	8.60	6.25
R23	407.01	60.29	7.01	90.19	22.97	20.25	8.87	6.25
R24	466.84	77.25	7.01	124.51	23.06	20.26	8.96	6.26
R25	410.69	61.75	7.14	92.24	22.94	20.27	8.84	6.27
R26	336.41	52.62	7.18	49.63	22.74	20.28	8.64	6.28
R27	382.42	74.45	7.22	76.02	22.83	20.30	8.73	6.30
R28	391.60	55.99	7.13	81.34	22.71	20.28	8.61	6.28
R29	377.60	67.73	7.18	72.61	23.15	20.29	9.05	6.29
R30	373.72	62.67	7.22	70.93	23.60	20.30	9.50	6.30
R31	393.12	68.15	7.23	81.72	23.72	20.30	9.62	6.30
R32	492.21	84.11	7.11	139.12	22.81	20.28	8.71	6.28
R33	410.13	67.37	7.10	90.88	22.84	20.28	8.74	6.28
R34	379.51	59.40	7.03	73.20	22.58	20.28	8.48	6.28
R35	339.64	42.88	6.86	51.49	22.51	20.25	8.41	6.25
R36	318.77	41.69	6.86	38.85	22.57	20.26	8.47	6.26
R37	304.09	59.07	6.72	30.70	22.64	20.25	8.54	6.25
R38	298.22	66.02	6.66	27.43	22.66	20.25	8.56	6.25
R39	341.17	54.46	6.50	52.19	22.61	20.23	8.51	6.23
R40	306.88	61.72	6.42	32.36	22.71	20.22	8.61	6.22
R41	268.00	39.61	29.48	47.32	22.13	20.21	8.09	6.21
Criteria	11,000	164	31	n/a	50	25	20	7

A.2 Predicted Cumulative Concentrations - Scenario 2

ID	Predicted Cumulative Concentration ($\mu\text{g}/\text{m}^3$)							
	CO	NO ₂		TVOC	PM10		PM2.5	
	8 hour	1 hour	Annual	Annual	24 hour	Annual	24 hour	Annual
R1	311.71	38.16	6.23	34.71	22.31	20.20	8.21	6.20
R2	292.48	32.91	6.32	23.80	22.43	20.21	8.33	6.21
R3	295.95	36.70	6.22	25.95	22.33	20.20	8.23	6.20
R4	292.39	29.64	6.21	24.24	22.21	20.20	8.11	6.20
R5	281.01	30.73	6.26	17.85	22.42	20.20	8.32	6.20
R6	284.89	30.86	6.27	20.06	22.40	20.20	8.30	6.20
R7	292.25	31.04	6.33	24.30	22.31	20.21	8.21	6.21
R8	319.32	47.84	6.48	39.88	22.49	20.22	8.39	6.22
R9	340.21	47.87	6.58	50.80	22.81	20.23	8.71	6.23
R10	390.93	55.95	6.64	81.06	22.78	20.24	8.68	6.24
R11	374.93	60.00	6.68	70.35	22.68	20.24	8.58	6.24
R12	316.73	45.07	7.06	37.41	22.85	20.28	8.75	6.28
R13	364.18	52.74	6.72	65.69	22.65	20.24	8.55	6.24
R14	315.19	57.13	6.73	37.49	22.84	20.24	8.74	6.24
R15	309.08	64.31	6.75	33.70	22.95	20.24	8.85	6.24
R16	311.39	68.47	6.78	33.87	23.14	20.25	9.04	6.25
R17	321.97	66.09	6.87	40.77	22.56	20.25	8.46	6.25
R18	314.74	63.15	6.75	36.31	22.66	20.25	8.56	6.25
R19	310.37	51.41	6.71	34.74	22.50	20.24	8.40	6.24
R20	308.75	42.64	6.74	33.32	22.77	20.25	8.67	6.25
R21	309.94	49.21	6.77	33.03	22.81	20.25	8.71	6.25
R22	307.83	57.05	6.77	32.09	22.70	20.25	8.60	6.25
R23	321.49	54.35	6.74	41.15	22.97	20.25	8.87	6.25
R24	348.78	67.70	6.77	56.82	23.06	20.26	8.96	6.26
R25	323.25	61.75	6.87	42.10	22.94	20.27	8.84	6.27
R26	289.35	52.62	6.91	22.65	22.74	20.28	8.64	6.28
R27	310.34	74.45	7.01	34.70	22.83	20.30	8.73	6.30
R28	314.48	55.27	6.91	37.11	22.71	20.28	8.61	6.28
R29	308.98	67.73	6.95	33.27	23.15	20.29	9.05	6.29
R30	306.51	62.67	7.00	32.39	23.60	20.30	9.50	6.30
R31	315.81	68.15	7.00	37.39	23.72	20.30	9.62	6.30
R32	360.28	50.21	6.89	63.48	22.81	20.28	8.71	6.28
R33	324.33	43.29	6.90	41.69	22.84	20.28	8.74	6.28
R34	310.53	40.04	6.84	33.64	22.58	20.28	8.48	6.28
R35	290.82	42.88	6.68	23.49	22.51	20.25	8.41	6.25
R36	282.16	41.69	6.70	17.86	22.57	20.26	8.47	6.26
R37	275.12	59.07	6.62	14.08	22.64	20.25	8.54	6.25
R38	272.30	66.02	6.58	12.57	22.66	20.25	8.56	6.25
R39	291.75	54.43	6.43	23.85	22.61	20.23	8.51	6.23
R40	276.30	61.71	6.37	14.83	22.71	20.22	8.61	6.22
R41	254.01	16.42	6.23	21.69	22.11	20.21	8.09	6.21
Criteria	11,000	164	31	n/a	50	25	20	7

A.3 Predicted Cumulative Concentrations - Scenario 3

ID	Predicted Cumulative Concentration ($\mu\text{g}/\text{m}^3$)							
	CO	NO ₂		TVOC	PM10		PM2.5	
	8 hour	1 hour	Annual	Annual	24 hour	Annual	24 hour	Annual
R1	303.58	35.86	6.23	29.95	22.31	20.20	8.21	6.20
R2	286.91	32.70	6.31	20.54	22.43	20.21	8.33	6.21
R3	289.86	35.92	6.22	22.39	22.33	20.20	8.23	6.20
R4	286.68	29.34	6.21	20.90	22.21	20.20	8.11	6.20
R5	276.79	30.61	6.26	15.38	22.42	20.20	8.32	6.20
R6	280.15	30.83	6.26	17.29	22.40	20.20	8.30	6.20
R7	286.51	29.66	6.32	20.94	22.31	20.21	8.21	6.21
R8	309.89	45.83	6.46	34.37	22.49	20.22	8.39	6.22
R9	328.30	44.51	6.55	43.83	22.81	20.23	8.71	6.23
R10	371.78	50.55	6.61	69.85	22.78	20.24	8.68	6.24
R11	358.44	55.35	6.65	60.70	22.68	20.24	8.58	6.24
R12	307.97	43.87	7.01	32.28	22.85	20.28	8.75	6.28
R13	348.66	52.73	6.69	56.61	22.65	20.24	8.55	6.24
R14	306.33	57.12	6.69	32.30	22.84	20.24	8.74	6.24
R15	301.14	64.29	6.72	29.05	22.95	20.24	8.85	6.24
R16	303.51	68.47	6.74	29.26	23.14	20.25	9.04	6.25
R17	312.39	66.08	6.82	35.16	22.56	20.25	8.46	6.25
R18	306.50	63.15	6.72	31.28	22.66	20.25	8.56	6.25
R19	302.16	51.41	6.68	29.94	22.50	20.24	8.40	6.24
R20	300.91	42.64	6.71	28.74	22.77	20.25	8.67	6.25
R21	302.26	49.21	6.73	28.53	22.81	20.25	8.71	6.25
R22	300.35	57.05	6.74	27.71	22.70	20.25	8.60	6.25
R23	311.76	54.35	6.71	35.46	22.97	20.25	8.87	6.25
R24	335.36	67.70	6.74	48.96	23.06	20.26	8.96	6.26
R25	313.30	61.75	6.85	36.28	22.94	20.27	8.84	6.27
R26	283.99	52.62	6.88	19.51	22.74	20.28	8.64	6.28
R27	302.14	74.45	6.98	29.90	22.83	20.30	8.73	6.30
R28	305.70	55.27	6.89	31.98	22.71	20.28	8.61	6.28
R29	301.18	67.73	6.92	28.70	23.15	20.29	9.05	6.29
R30	298.86	62.67	6.97	27.92	23.60	20.30	9.50	6.30
R31	307.02	68.15	6.98	32.24	23.72	20.30	9.62	6.30
R32	345.28	50.21	6.87	54.70	22.81	20.28	8.71	6.28
R33	314.57	40.54	6.88	35.98	22.84	20.28	8.74	6.28
R34	302.68	38.82	6.82	29.05	22.58	20.28	8.48	6.28
R35	285.26	42.88	6.66	20.24	22.51	20.25	8.41	6.25
R36	278.00	41.69	6.68	15.42	22.57	20.26	8.47	6.26
R37	271.82	59.07	6.60	12.15	22.64	20.25	8.54	6.25
R38	269.36	66.02	6.57	10.85	22.66	20.25	8.56	6.25
R39	286.13	54.43	6.42	20.56	22.61	20.23	8.51	6.23
R40	272.83	61.71	6.37	12.79	22.71	20.22	8.61	6.22
R41	268.00	39.61	29.48	18.72	22.13	20.21	8.09	6.21
Criteria	11,000	164	31	n/a	50	25	20	7

A.4 Predicted Cumulative Concentrations - Scenario 4

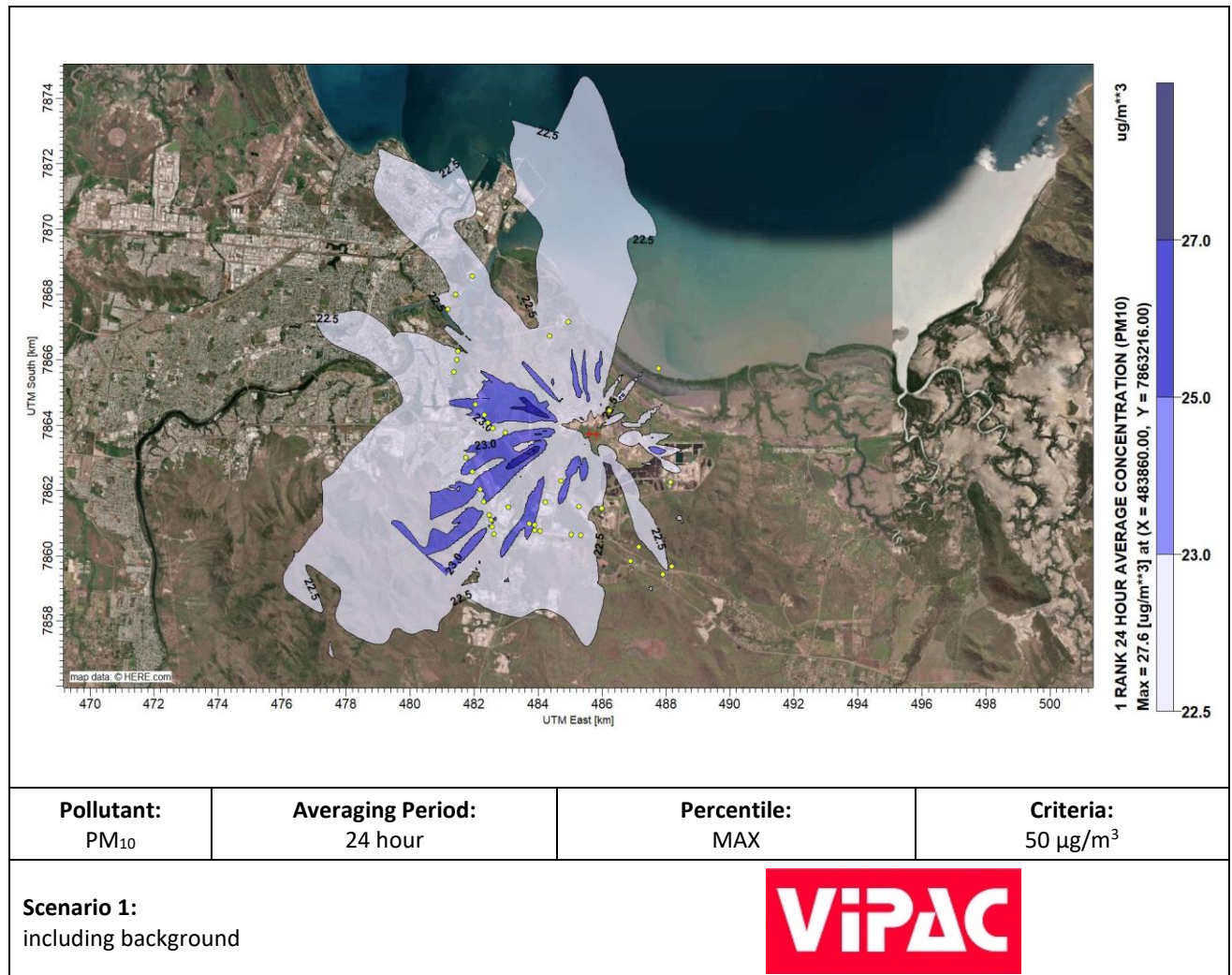
ID	Predicted Cumulative Concentration ($\mu\text{g}/\text{m}^3$)							
	CO	NO ₂		TVOC	PM10		PM2.5	
	8 hour	1 hour	Annual	Annual	24 hour	Annual	24 hour	Annual
R1	267.92	29.03	6.22	9.48	22.31	20.20	8.21	6.20
R2	262.50	31.75	6.26	6.53	22.43	20.21	8.33	6.21
R3	263.16	35.00	6.22	7.06	22.33	20.20	8.23	6.20
R4	261.62	28.04	6.21	6.51	22.21	20.20	8.11	6.20
R5	258.30	30.09	6.23	4.76	22.42	20.20	8.32	6.20
R6	259.38	30.72	6.24	5.36	22.40	20.20	8.30	6.20
R7	261.35	24.89	6.27	6.49	22.31	20.21	8.21	6.21
R8	270.35	37.17	6.35	10.64	22.49	20.22	8.39	6.22
R9	276.09	36.89	6.43	13.86	22.81	20.23	8.71	6.23
R10	287.79	36.99	6.49	21.63	22.78	20.24	8.68	6.24
R11	286.13	37.64	6.51	19.19	22.68	20.24	8.58	6.24
R12	269.92	41.01	6.82	10.25	22.85	20.28	8.75	6.28
R13	280.59	52.69	6.53	17.53	22.65	20.24	8.55	6.24
R14	267.49	57.06	6.53	10.01	22.84	20.24	8.74	6.24
R15	268.10	64.23	6.55	9.07	22.95	20.24	8.85	6.24
R16	269.61	68.47	6.57	9.43	23.14	20.25	9.04	6.25
R17	270.40	66.02	6.63	11.05	22.56	20.25	8.46	6.25
R18	270.38	63.15	6.57	9.95	22.66	20.25	8.56	6.25
R19	266.15	51.41	6.53	9.27	22.50	20.24	8.40	6.24
R20	268.11	42.64	6.56	9.02	22.77	20.25	8.67	6.25
R21	268.61	49.21	6.58	9.21	22.81	20.25	8.71	6.25
R22	267.56	57.05	6.59	8.89	22.70	20.25	8.60	6.25
R23	269.12	54.35	6.58	10.97	22.97	20.25	8.87	6.25
R24	276.49	67.70	6.62	15.16	23.06	20.26	8.96	6.26
R25	269.69	61.75	6.72	11.24	22.94	20.27	8.84	6.27
R26	263.64	52.62	6.75	6.04	22.74	20.28	8.64	6.28
R27	271.86	74.45	6.88	9.26	22.83	20.30	8.73	6.30
R28	267.24	55.27	6.78	9.90	22.71	20.28	8.61	6.28
R29	269.33	67.73	6.81	9.06	23.15	20.29	9.05	6.29
R30	267.43	62.67	6.86	8.67	23.60	20.30	9.50	6.30
R31	269.49	68.15	6.87	10.11	23.72	20.30	9.62	6.30
R32	279.49	50.21	6.77	16.93	22.81	20.28	8.71	6.28
R33	271.79	39.23	6.78	11.42	22.84	20.28	8.74	6.28
R34	268.28	38.82	6.72	9.30	22.58	20.28	8.48	6.28
R35	260.91	42.88	6.57	6.26	22.51	20.25	8.41	6.25
R36	259.74	41.69	6.60	4.94	22.57	20.26	8.47	6.26
R37	266.07	59.07	6.55	3.86	22.64	20.25	8.54	6.25
R38	268.60	66.02	6.53	3.43	22.66	20.25	8.56	6.25
R39	264.34	54.42	6.39	6.41	22.61	20.23	8.51	6.23
R40	267.07	61.71	6.35	4.04	22.71	20.22	8.61	6.22
R41	254.01	39.61	29.48	5.92	22.13	20.21	8.09	6.21
Criteria	11,000	164	31	n/a	50	25	20	7

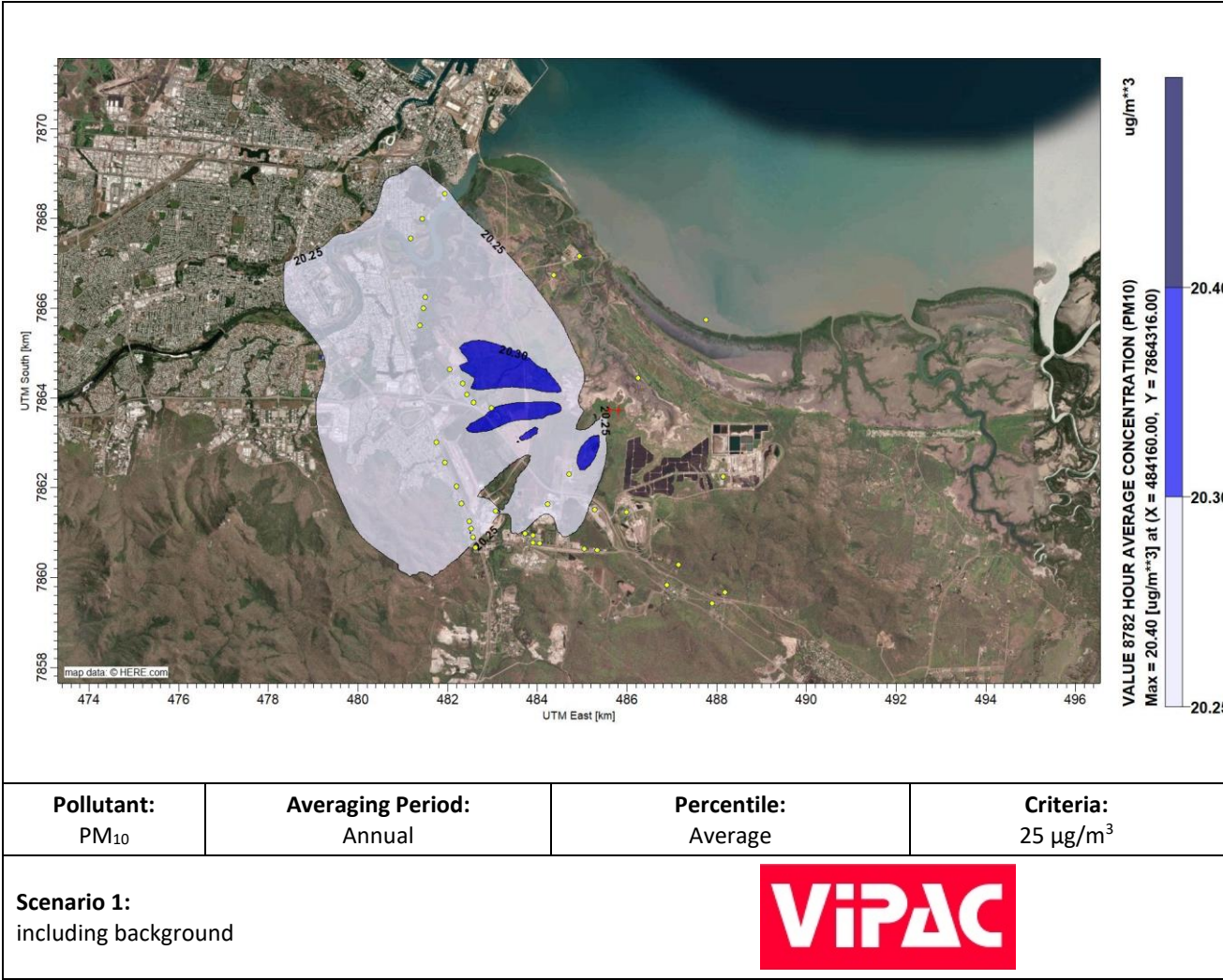
Appendix B Contour Plots

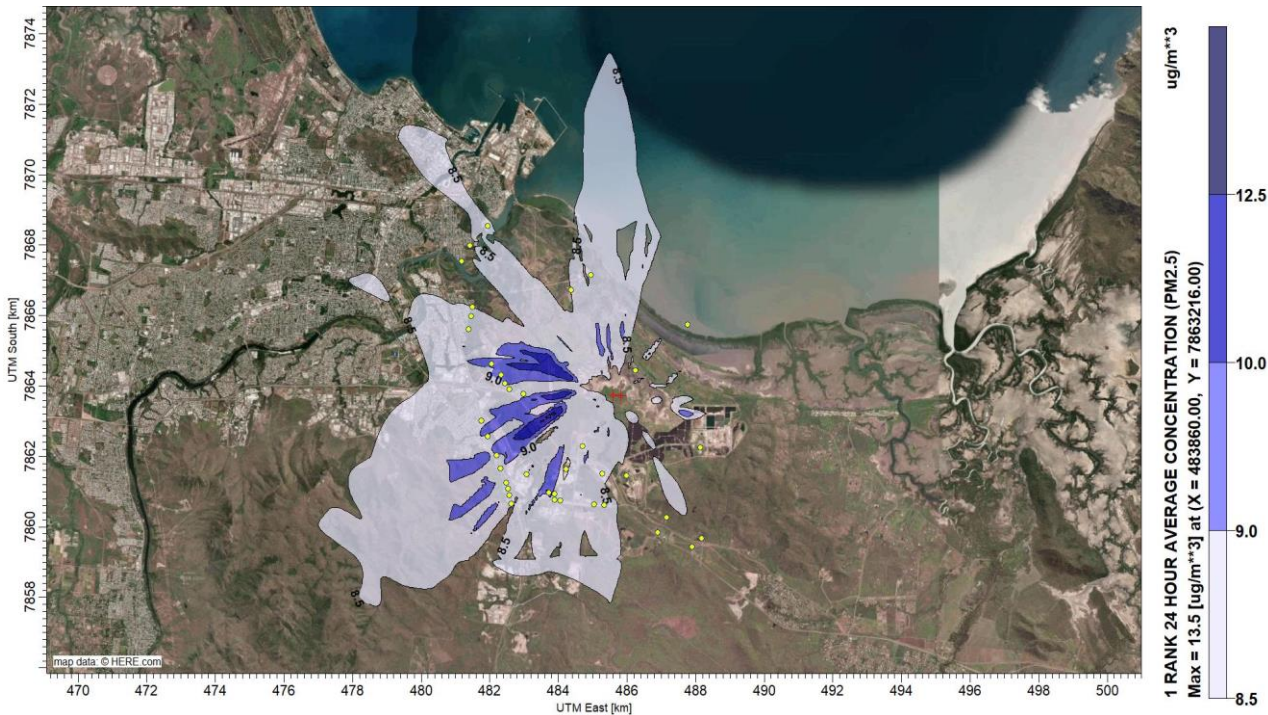
The contour plots are created from the predicted ground-level concentrations at the network of gridded receptors within the modelling domain at frequent intervals. These gridded values are converted into contours using triangulation interpolation in the CALPOST post-processing software within the CALPUFF View software (Version 8.4 - September 2016).

Contour plots illustrate the spatial distribution of ground-level concentrations across the modelling domain for each time period of concern. However, this process of interpolation causes a smoothing of the base data that can lead to minor differences between the contours and sensitive model predictions.

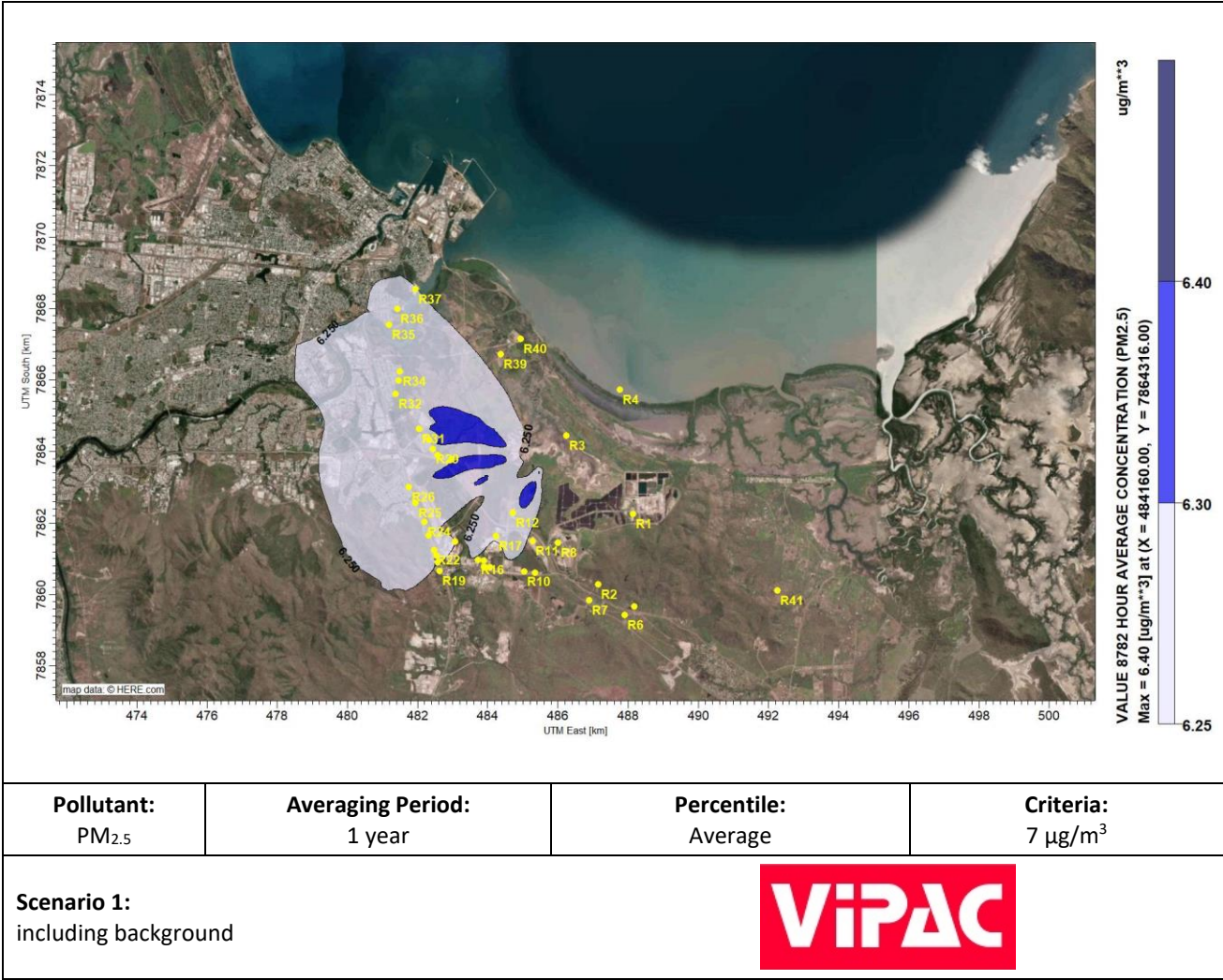
The contour plots are provided for the worst-case (i.e. maximum predictions) operational scenario for non-routine operations. As discussed in section 3.1.1, construction emissions are not typically modelled and contour plots for this scenario are therefore not presented here.

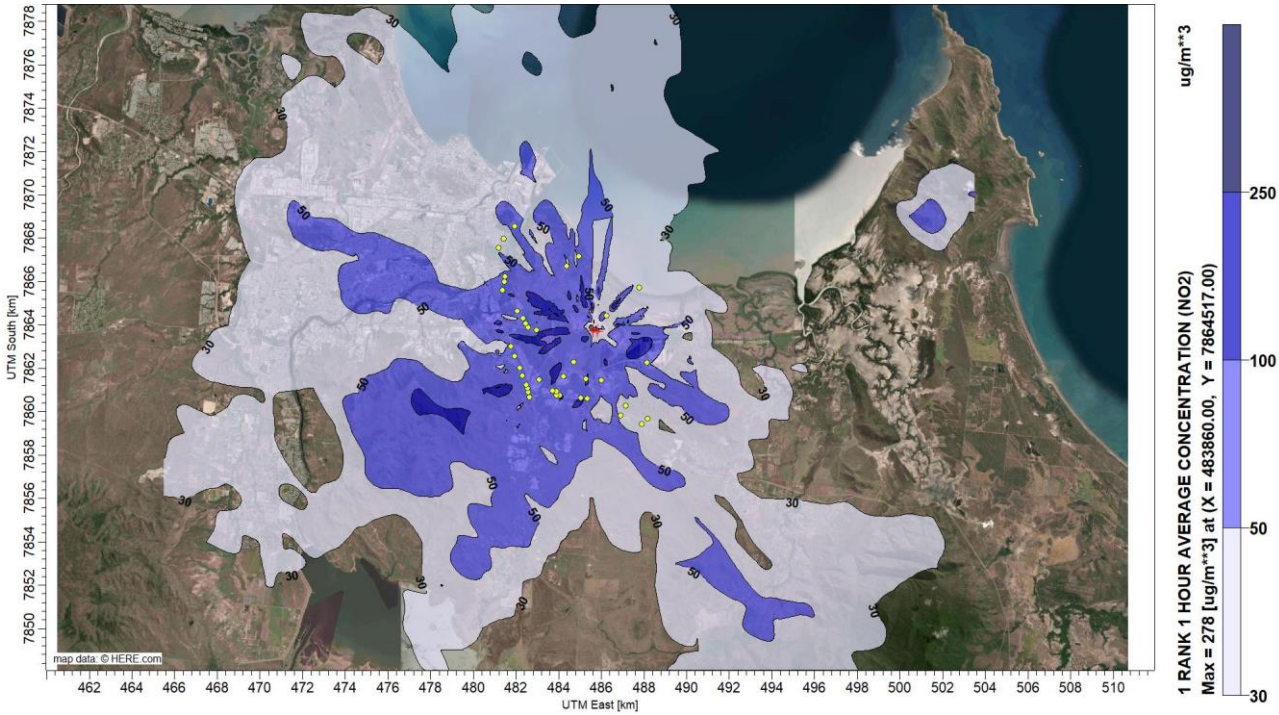






Pollutant: PM _{2.5}	Averaging Period: 24 hour	Percentile: MAX	Criteria: 20 µg/m³
Scenario 1: including background			

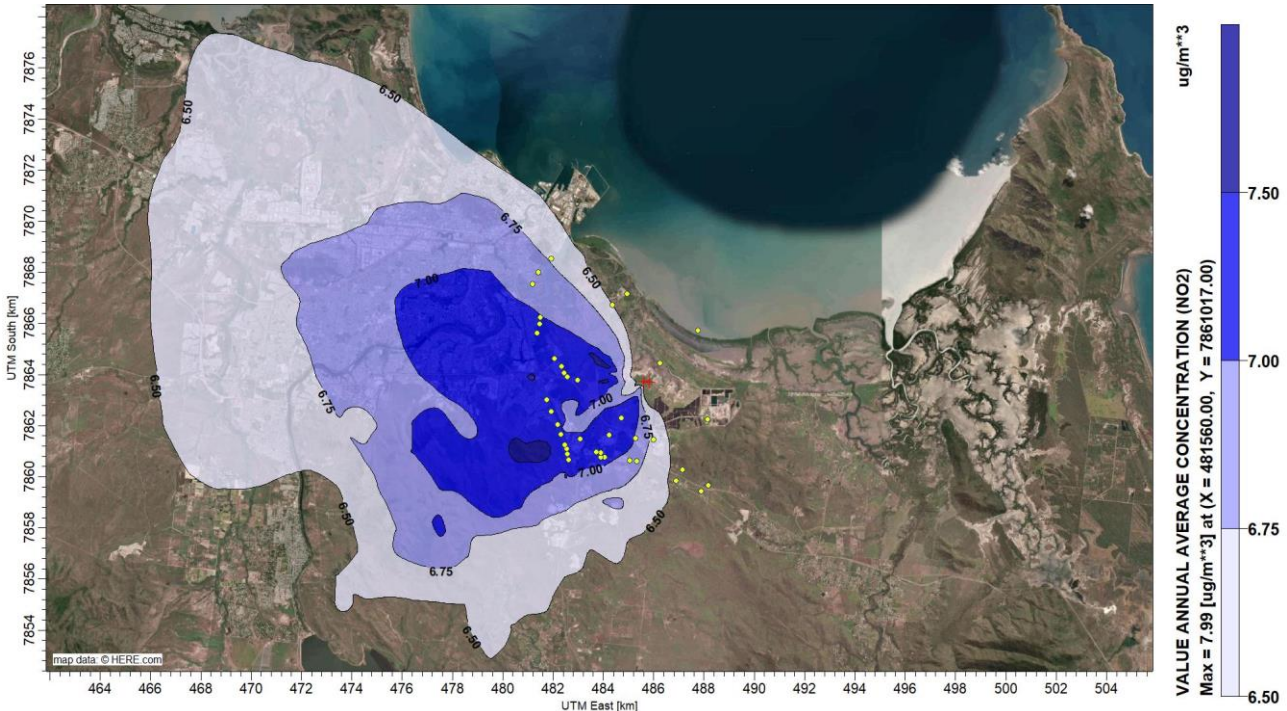




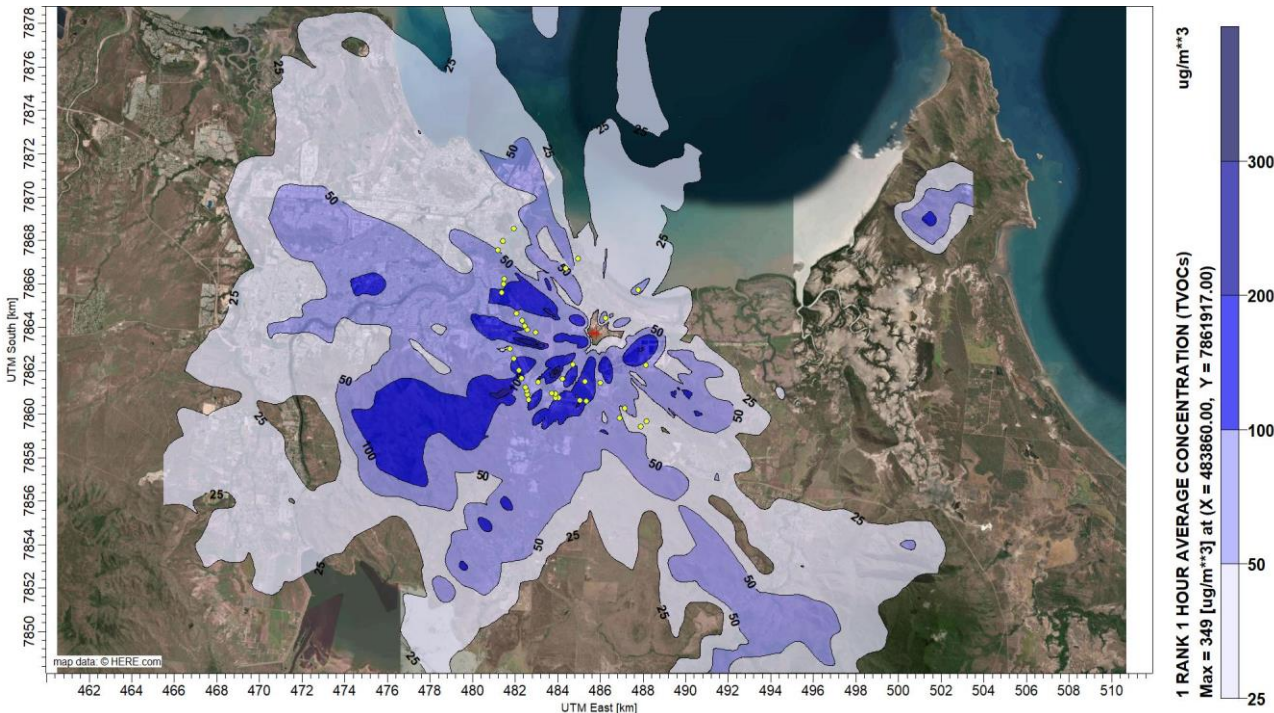
Pollutant: NO ₂	Averaging Period: 1-hour	Percentile: MAX	Criteria: 164 µg/m ³
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Scenario 1:
including background

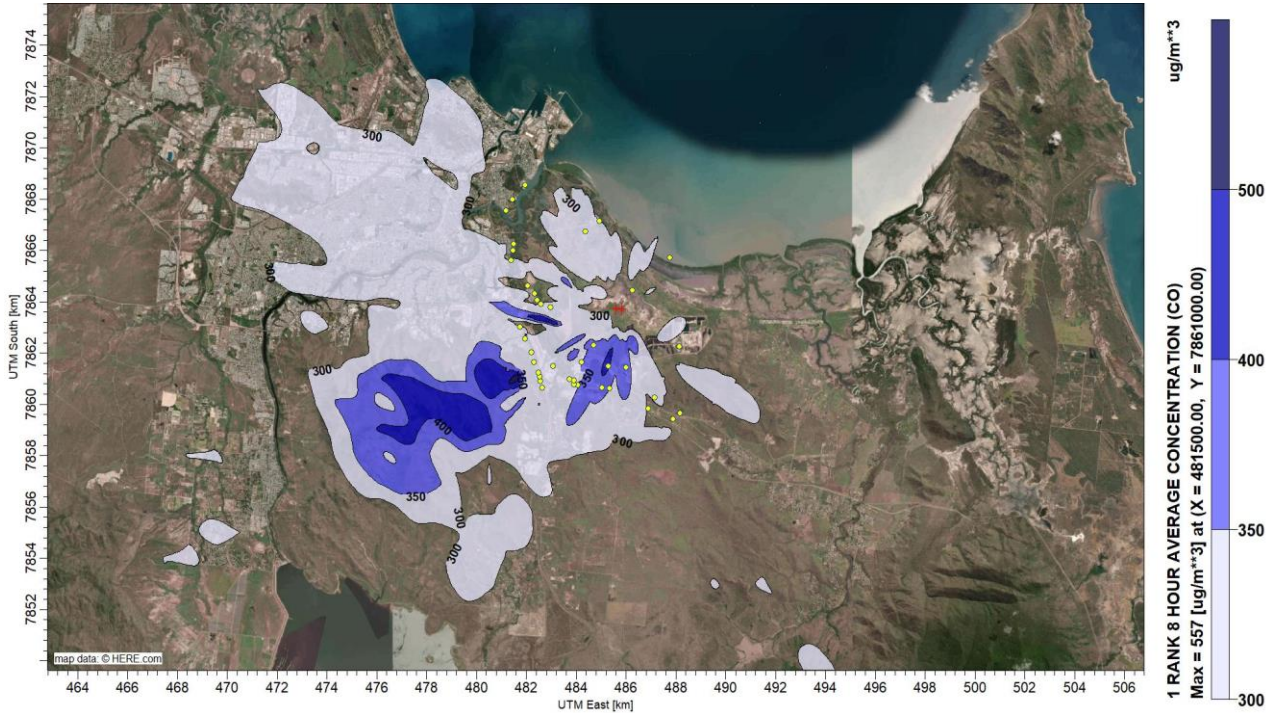




Pollutant: NO ₂	Averaging Period: Annual	Percentile: Average	Criteria: 31 $\mu\text{g}/\text{m}^3$
Scenario 1: including background			



Pollutant: TVOCs	Averaging Period: 1 hour	Percentile: Max	Criteria: varies
Scenario 1: In isolation			



Pollutant: CO	Averaging Period: 8 hours	Percentile: MAX	Criteria: 11,000 µg/m ³
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Scenario 1:
including background

VIPAC