PHGS Project – Dust Emissions Assessment

Air Quality Modelling Assessment

Final Report
Version 2

Prepared for Port Hedland Green Steel Pty Ltd

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PHGS Project – Dust Emissions Assessment

Final Report

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Signature		

Executive Summary

Port Hedland Green Steel Pty Ltd is evaluating the feasibility of developing a large-scale downstream processing capability at the Boodarie Strategic Industrial Area (BSIA) in Port Hedland, Western Australia. This development, the Port Hedland Green Steel Project (the Project), will source magnetite concentrate from iron ore operations in the Pilbara to produce Hot Briquetted Iron (HBI) for export to customers who will convert the HBI into a low carbon emission steel overseas. Port Hedland Green Steel Pty Ltd has commissioned Preston Consulting Pty Ltd (Preston Consulting) to engage and contract all relevant environmental studies.

The Project will be developed in stages, with Stage 1 consisting of developing the Iron Ore Processing Facility consisting of a Pellet Plant which will consume approximately 3 - 3.5 million tonnes per annum (Mtpa) of iron ore (trucked in from iron ore operations in the Pilbara) and a HBI Plant which will further process approximately 2 Mtpa of the pellets into HBI. The disturbance footprint for Stage 1 of the Project will likely be around 300 – 400 hectares (ha) within the BSIA.

Port Hedland Green Steel Pty Ltd plan to seek approval under Part IV of the *Environmental Protection Act 1986* (EP Act) to enable the development of the Project.

Overview of assessment

The potential impacts were determined through a dispersion modelling study, which incorporated site-specific meteorological data, emissions information, source characteristics, and the location of model receptors. An inventory of particulate (dust) emissions from the current operations was developed and projected for the change in operations.

Emission rates for the Project were undertaken using source specific emission factors, while the emissions for the transfer of materials were undertaken with emission factors sourced from the NPI Emission Estimation Technique Manual (EETM) for Mining. The study adopted a conservative approach, consistent with similar assessments in the region, using AERMOD software (version 9.4).

Ground-level particulates (as PM_{10} concentrations) were predicted at sensitive receptors and the surrounding environment using the Port Hedland Industries Council Cumulative Air Model (AERMOD) and were compared with the relevant air quality assessment criteria. Predicted project contributions were presented in isolation of non-project related emission sources, and with the inclusion of background and existing concentrations to represent the potential changes in cumulative impacts in the Port Hedland area.

Key findings

Modelling was undertaken for:

- A stand-alone scenario where 3.5 million tonnes of Ore was processed into pellets and 2 million tonnes were further processed into hot briquettes (HBI).
- A cumulative model combining the stand-alone scenario with the existing PHIC cumulative emissions.

The results of the modelling, at selected receptors, predict for the:

- Standalone scenario (i.e. The Project in isolation of other emission sources and no background):
    - For PM_{10}:

        - At the Taplin St receptor all of the predicted 24-hour averaged PM_{10} concentrations are below 1 µg/m^3.
        - The highest predicted impact will be 3.2 µg/m^3 at the South Hedland receptor, with the lower percentile results being significantly lower.
    - For $PM_{2.5}$:
        - At the Taplin St receptor all of the predicted 24-hour averaged $PM_{2.5}$ concentrations are well below 1 µg/m^3.
- Scenario 3 which is a cumulative model of the PHIC network including the Project with background, for both PM_{10} and $PM_{2.5}$:
    - There is no predicted change to the number of excursion of the criteria at the Taplin St receptor
    - There is no predicted change to the maximum predicted 24-hour concentration at the Taplin St receptor.
    - There are no predicted changes to the maximum predicted 24-hour concentration at either the Wedgefield or South Hedland receptors.

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1 Introduction

1.1 Background

Port Hedland Green Steel Pty Ltd (PHGS) is evaluating the feasibility of developing a large-scale downstream processing capability at the Boodarie Strategic Industrial Area (BSIA) in Port Hedland, Western Australia. This development, the Australia Green Steel Project (the Project), will source magnetite concentrate from iron ore operations in the Pilbara to produce Hot Briquetted Iron (HBI) for export to customers who will convert the HBI into a low carbon emission steel overseas.

The Project will be developed in stages, with Stage 1 consisting of developing the Iron Ore Processing Facility consisting of a Pellet Plant which will consume approximately 3 - 3.5 million tonnes per annum (Mtpa) of iron ore (trucked in from iron ore operations in the Pilbara) and a HBI Plant which will further process approximately 2 Mtpa of the pellets into HBI. The disturbance footprint for Stage 1 of the Project will likely be around 300 – 400 hectares (ha) within the BSIA. PHGS plan to seek approval under Part IV of the *Environmental Protection Act 1986* (EP Act) to enable the development of the Project.

1.2 Scope of work

The scope of work includes:

- Development of an emissions inventory for Stage 1:
    - Particulate emissions associated with material handling including truck unloading, stacking, reclaiming and associated transfer stations and conveyors.
        - Particulate emissions associated with both the proposed Pellet and HBI plants.
- Atmospheric dispersion modelling for the proposed emission scenario.
    - The modelling will be undertaken using the updated PHIC CAM (AERMOD), with relevant modelling files provided by PHIC.
    - This will include the validated meteorological and background data as well as specified model configurations and in accordance with the Air Quality Modelling Guidance Notes (DER, 2006).
- The modelled results will be compared to the interim air quality criteria as detailed in the '*Port Hedland Regulatory Strategy, 2021*'.

The scenarios considered are:

- Scenario 1: Base case, PHIC network emissions with background (not including Port Hedland Green Steel)
- Scenario 2: The Project without background
- Scenario 3: Cumulative model of PHIC and the Project with background.

This report outlines the methodology for the emission estimation and atmospheric modelling of the predicted dust impacts associated with the Project. The report presents the predicted ground level concentrations of dust with the proposed project and makes comparison to the dust performance targets specified in the Port Hedland Regulatory Strategy (DWER, 2021). Further reference is also made to the Department of Water and Environmental Regulation (DWER) Industry Regulation fact sheet 'Managing dust in Port Hedland' (DWER, 2018). Modelling of potential cumulative emissions was also undertaken as part of this assessment. Emissions from the BHP operations at Nelson Point and Finucane Island, Pilbara Ports Authority (PPA) Utah Point (multi-user) operations, Roy Hill Facility, and the Fortescue Metals Group (Fortescue) operations at Anderson Point.

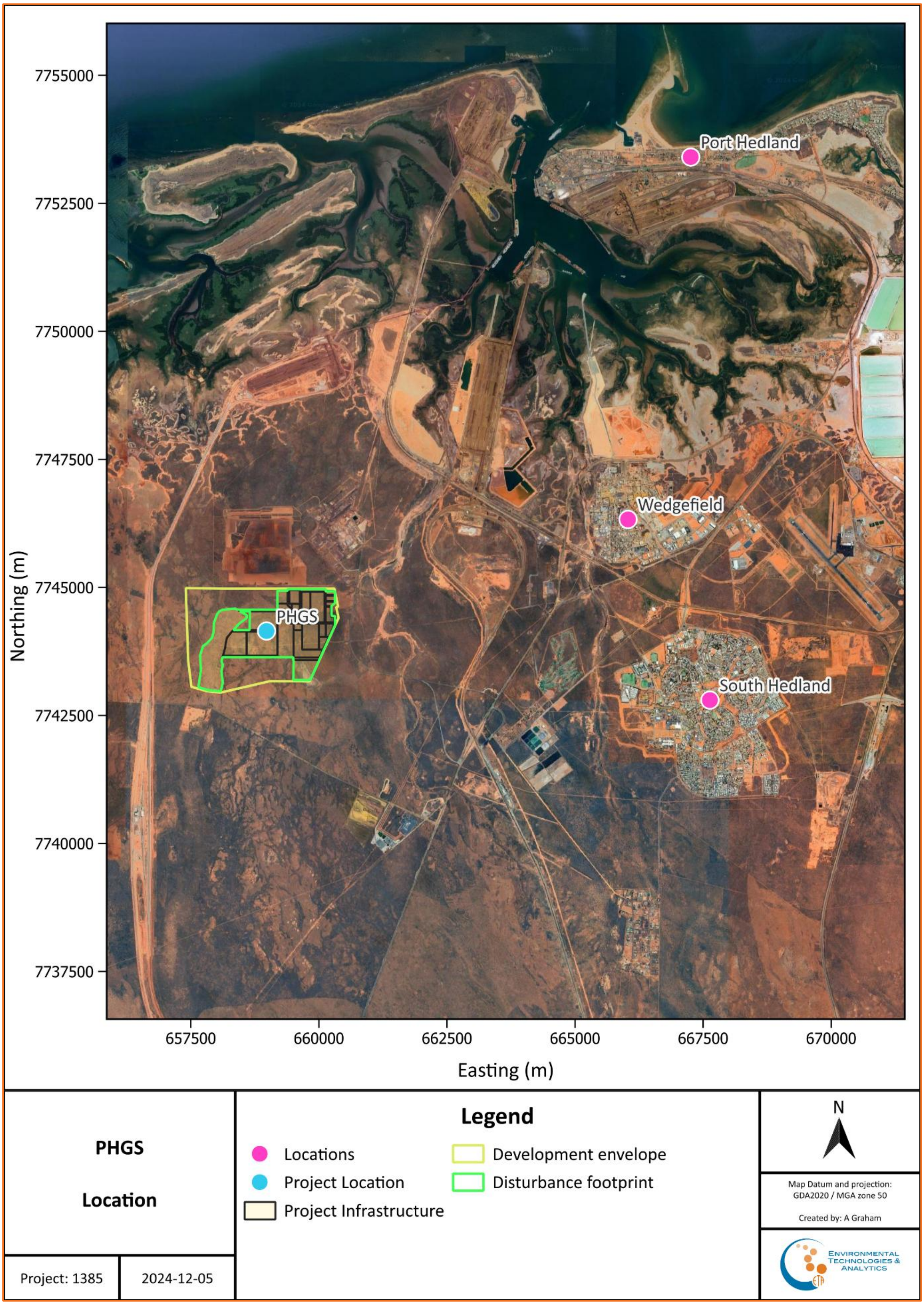

Figure 1-1: Project location and setting.

1.3 Structure of report

This report describes the methods and findings of an assessment of the potential impacts to the air environment arising from the Project. The assessment includes:

- The study approach and methodology in Section 2.
- Project emission estimation and inventory in Section 3.
- An evaluation of the predicted ground-level concentrations and interpretation of the potential impact of the Project (Section 4)
- Conclusions of the assessment presented in Section 5.

The appendices contain supporting information.

2 Assessment methodology

The following section outlines the methodology utilised in the assessment of the potential changes in the air quality resulting from the proposed development of the Project.

2.1 Dispersion Modelling

During 2014 and 2015 the Port Hedland Industries Council (PHIC) undertook an extensive atmospheric dispersion model validation project where it was determined that both AERMOD and CALPUFF were suitable models to determine the potential impact from industrial sources in the area. In brief:

- AERMOD is the acronym or common name for the AERMIC Dispersion Model. It was designed by the AERMIC Committee (the American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee) to treat elevated and surface emission sources in terrain that is simple or complex (Perry, Cimorelli et al, 2005). In 2013 AERMOD replaced AUSPLUME as the regulatory model for air quality assessments in Victoria by the Victorian Environmental Protection Authority (EPAV).
- CALPUFF is the dispersion module of the CALMET/CALPUFF suite of models. It is a multi-layer, multi species, non-steady-state puff dispersion model that can simulate the effects of time-varying and space-varying meteorological conditions on pollutant transport, transformation and removal. The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across released puffs and considers the complex arrangement of emissions from point, area, volume and line sources (Scire et al., 2008).

2.2 AERMOD Modelling

For this assessment, the dispersion model AERMOD (version 12) was used. The primary reason for using this model is that other proponents in the region, particularly BHP and Fortescue, are using AERMOD for their own approvals process. By using AERMOD this assessment ensures consistency in evaluating cumulative impact predictions with other assessments within the region.

The model was configured in accordance with the work undertaken as a part of the PHIC Cumulative Air Model (CAM) (PEL, 2015). As noted in the PHIC CAM report (PEL, 2015) there are some constraints that need to be considered when using the PHIC CAM (AERMOD) including:

- The model may over-predict concentrations at Richardson St.
- At the Kingsmill St and Taplin St receptors the model results are considered to be reasonable reflections of actual monitored air quality.
- The number of excursions of the interim target at Taplin St are considered to be reasonable reflections.

To undertake the air quality assessment, emission estimation and modelling were undertaken for the following scenarios:

- A stand-alone scenario where 3.5 million tonnes of Ore was processed into pellets and 2 million tonnes were further processed into hot briquettes (HBI).
- A cumulative model, with other existing, approved, and planned operations in the region including -
    - BHP at 330 Mtpa

- PPA at 28 Mtpa
- Fortescue at 210 Mtpa
- North West Infrastructure at 50 Mtpa
- Roy Hill Facility at 70Mtpa.

2.3 Meteorological File

The AERMOD modelling incorporated the meteorological file developed as part of the PHIC (CAM) project which has been accepted for use by the Western Australian (WA) Department of Water and Environment Regulation (DWER).

A summary of the stability and mixing heights of the PHIC CAM meteorological file is provided in Appendix A.

2.4 Grid system

The modelling undertaken as part of this assessment utilised the same receptors, and their locations, as that contained within the PHIC CAM report (PEL, 2015). These receptors, and their coordinates, are listed in Table 2-1 and presented graphically in Figure 2-1. Note that due to the number of receptors within the Town of Port Hedland the name of each receptor was not incorporated into the figure, instead each receptor has been assigned a number. These numbers correspond to those listed in Table 2-1.

Table 2-1: Receptors, and locations, used in assessment

Number	Receptor	Easting (m)	Northing (m)
1	Harbour	664,350	7,753,240
2	Richardson Street	664,763	7,753,402
3	BMX	665,281	7,753,352
4	Kingsmill Street	665,508	7,753,450
5	Historic Hospital Site	665,870	7,753,420
6	Taplin Street	667,030	7,753,435
7	St Celia's School	667,292	7,753,390
8	Holiday Inn	667,780	7,753,480
9	Shop	668,050	7,753,280
10	All Seasons Inn	668,140	7,753,530
11	Council	668,450	7,753,640
12	Neptune Place	669,441	7,754,077
13	Primary School	670,631	7,754,008
14	South Hedland	666,600	7,743,439
15	Wedgefield	665,526	7,747,107

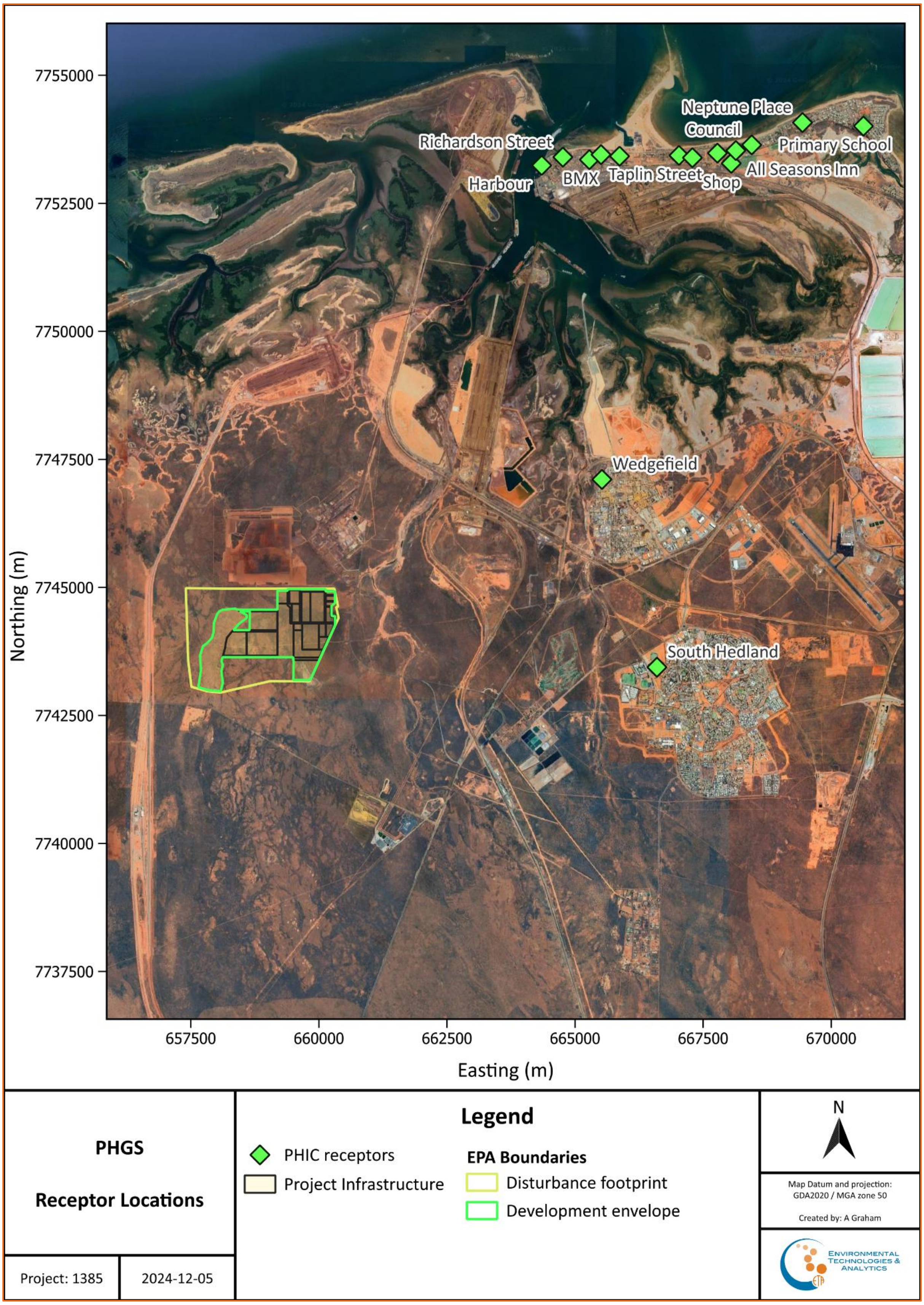

Figure 2-1: Location of receptors used in assessment.

2.5 Air quality assessment criteria

Modelled ground level concentrations for particulates have been compared to ambient air quality assessment criteria to determine the potential changes in impact resulting from the Project.

The assessment criteria adopted for this study (for particulates) are primarily based on the DWER (2019; 2021) guidelines, which also reference the numerical values from the ambient air quality standards specified in the Ambient Air Quality NEPM (NEPC, 2021).

In their current draft form, the DWER (2019) guidelines for PM_{10}/$PM_{2.5}$ (defined as *criteria pollutants* in the guideline) require the criteria to generally be '…met at all existing and future offsite sensitive receptors in the modelling domain'. DWER (2021) draft guidelines address the settling or deposition of dust, noting that at time of this assessment the guideline is draft and subject to public consultation. The guidelines also state that the department may approve deviations to the assessment criteria on a case-by-case basis.

For Port Hedland specifically, the Port Hedland Regulatory Strategy (DWER, 2021) adopted the Dust Management Taskforce (Taskforce) interim guideline value of 70 µg/m^3 for PM_{10} (24-hour average) as an Air Guideline Value (AGV). This AGV applies to residential areas in Port Hedland, wherever people live on a permanent basis.

The ambient air quality assessment criteria adopted in this study are shown in Table 2-2.

Table 2-2: Ambient Air Quality Standards and Goals

Pollutant	Air quality assessment criteria					Reference
	Concentration [1]	Concentration [2]	Averaging Period	Allowable Exceedances	Environmental value protected	
PM_{10}	25 µg/m^3	23 µg/m^3	annual	none	Human health	DWER (2021) consistent with NEPM (NEPC, 2021)
PM_{10}	70 µg/m^3	-	24-hour average	Not more than 10 days a year	Human health	Taskforce criteria (DSD, 2016)
$PM_{2.5}$	25 µg/m^3	23 µg/m^3	24-hour	exception event	Human health	DWER (2021) consistent with NEPM (NEPC, 2021)
$PM_{2.5}$	8 µg/m^3	8 µg/m^3	annual	none	Human health	DWER (2021) consistent with NEPM (NEPC, 2021)

Notes:
1 Concentrations referenced to 0ºC
2 Concentrations referenced to 25ºC

2.6 Background concentrations

It has long been recognised that the Pilbara region, due to its semi-arid climate, is a naturally dusty environment. This was highlighted in the aggregated emission study undertaken by SKM in 2000 (SKM, 2003) which calculated that the Pilbara region emitted approximately 170,000 tonnes of windblown particulates for the financial year 1999/2000. The naturally dusty environment is also apparent from the monitoring data from the PHIC Yule River monitor. This monitor is located approximately 42 kilometres (km) south-west of Port Hedland and is indicative of regional concentrations. The number of excursions of the 50 µg/m^3 NEPM criteria for particulates (as PM_{10}) for each financial year since 2012/2013 (FY13) are presented in Table 2-3.

From Table 2-3 it is apparent that there can be a large annual variation in the number of excursions of the NEPM PM_{10} criteria ranging from 24 in FY13 down to 1 in FY17 and FY22. This indicates that the quantity of particulates can vary significantly from year to year and that the background file used in the assessment should be considered as indicative only.

Table 2-3: Number of annual excursions of the PM_{10} NEPM criteria at Yule River

Financial Year	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23
Number of excursions	24	8	18	5	1	8	15	13	8	1	20

For this assessment the PHIC CAM background file was utilised and the methodology for the development of this file is outlined in PEL (2015). The PEL (2015) report also noted that due to the way the file was calculated there is a high probability that not all fugitive sources within the Port Hedland region were accounted for. This provides further indication that the file should be considered as indicative only. The 24-hour statistics for the PHIC CAM background file are presented in Table 2-4 and presented graphically in Figure 2-2. From this table it is apparent that the maximum 24-hour concentration is higher than the criteria which will affect the analysis of the modelling results, particularly when the maximum predicted concentrations, with background, are presented.

Table 2-4: Statistics of 24-hour PM_{10} PHIC CAM background file

Statistic	Concentration (µg/m^3)
Maximum	183
99th Percentile	53
95th Percentile	36
90th Percentile	32
70th Percentile	25
Average	22
Count >50 µg/m^3	5
Count >70 µg/m^3	1

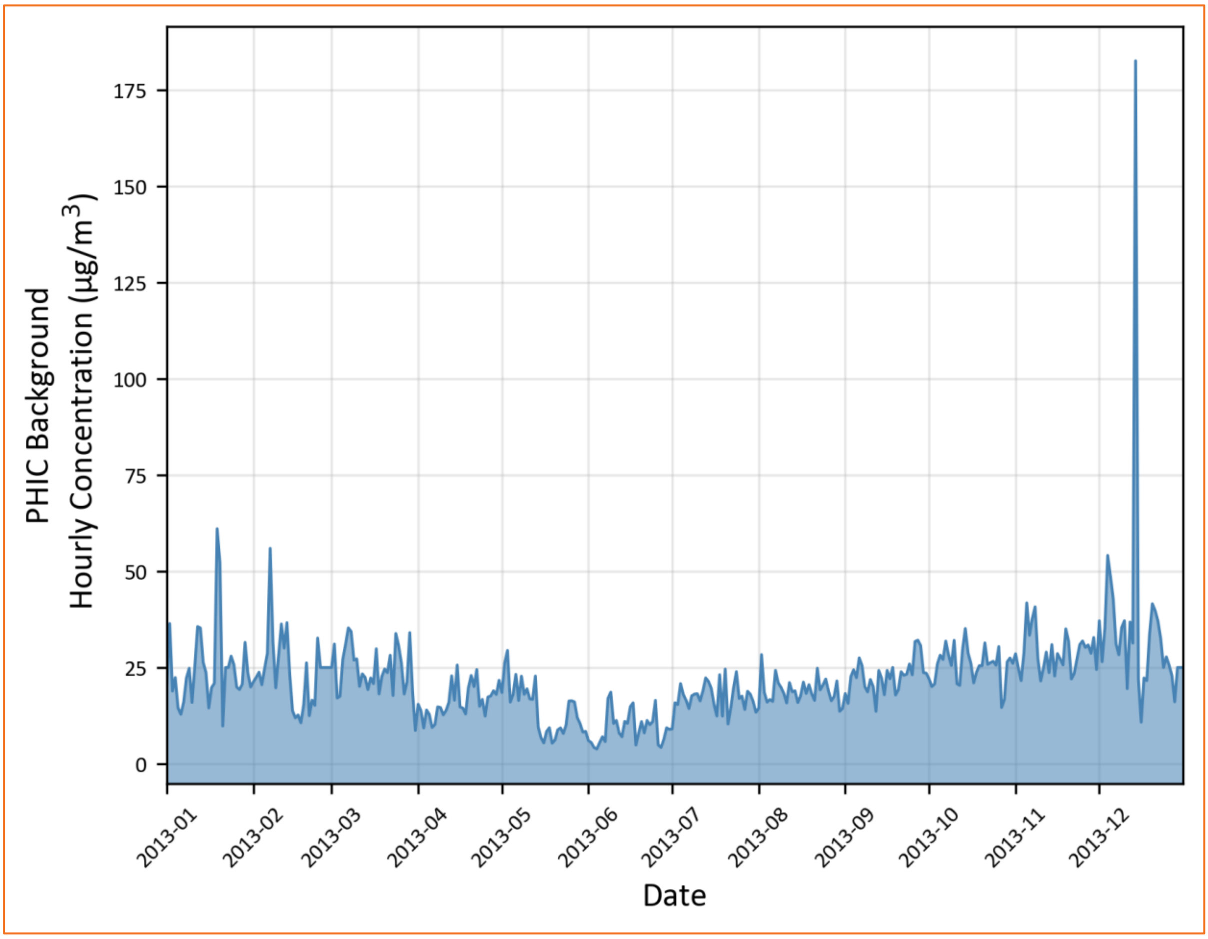

Figure 2-2: PHIC CAM background PM_{10} 24-hour concentrations (µg/m^3).

As outlined in PEL (2015) the background file developed for the PHIC CAM was only for PM_{10} and the model has only been validated for this particle size. To assist in determining a potential $PM_{2.5}$ background file the validated hourly data of PM_{10} and $PM_{2.5}$ from the Taplin Street monitor from 1 January 2020 to 31 December 2023 was obtained from PHIC. The following processes were undertaken to assist in determining a PM_{10} to $PM_{2.5}$ conversion factor:

- Hourly data was converted to a 24-hour average (from midnight to midnight).
- The PM_{10} to $PM_{2.5}$ ratio was calculated for each valid 24-hour monitoring period. A valid period occurs when:
  - There is both a PM_{10} and $PM_{2.5}$ concentration for each 24-hour period,
  - The $PM_{2.5}$ daily average concentration is above 0 µg/m^3.
  - The $PM_{2.5}$ daily average concentration is less than the corresponding PM_{10} concentration.

This data is presented in Table 2-5 where it is apparent that there is some inter-annual variation in the ratio of PM_{10}:$PM_{2.5}$ an overall average ratio of 0.20 would be applicable.

To obtain an indicative assessment of $PM_{2.5}$ in this assessment the PM_{10} model results, for both the existing and approved operations and the Project, were scaled using a factor of 0.20.

Table 2-5: Determining background $PM_{2.5}$ from PM_{10} concentrations.

Year	Ratio	Data Point
2020	0.16	280
2021	0.20	352
2022	0.18	334
2023	0.20	267

2.7 Model uncertainty

Atmospheric dispersion models represent a simplification of the many complex processes involved in approximating ground-level concentrations of substances. The model uncertainties are associated with model chemistry and physics, data, and stochastic uncertainties. There are also inherent uncertainties in the behaviour of the random turbulence of the atmosphere.

Factors contributing to the general uncertainty in model results include:

- the turbulent (random) nature of dispersion in the turbulent atmosphere.
- inaccuracies in the mathematical description of the physical and chemical processes that occur in the atmosphere (i.e. uncertainties in the numerical solutions).
- stochastic uncertainties, as models predict 'ensemble mean' concentrations (i.e. they predict the mean concentrations that would result from a large set of observations under the specific conditions being modelled).
- data uncertainty or variability, particularly in emission information and meteorological data inputs.

Regarding emissions information in particular, as predicted concentrations are proportional to emission rates, any errors in the emission rates will cause a proportional error in the model's predictions.

The uncertainty in modelling of extreme events, such as the maximum 1-hour ground-level concentration, is greater than the uncertainty in predicting concentrations averaged over a longer time period. Similarly, uncertainty in modelling the maximum predicted ground-level concentration at a discrete location is greater than the uncertainty in the maximum concentration predicted across the entire modelled domain. This is because the modelled concentration at a particular location is very sensitive to small changes in wind direction.

To ensure that potential air quality impacts are not underestimated, conservative assumptions have been applied as appropriate, to address key areas of uncertainty to provide over-predictions rather than under-predictions of ground-level concentrations.

3 Emissions to air estimation

When determining the potential impact of a facility, either existing or proposed, one of the critical inputs is the source emission file. The following sections outline the process whereby potential sources are identified, and quantified, based on the forecast throughput tonnage of the facility.

3.1 Emission Sources

The location of the fugitive dust emitting sources at the Project are displayed in Figure 3-1. The coordinates for each of the modelled sources, along with the model parameters, is presented in Appendix B. Important points considered for emissions sources were:

- Emissions sources are focussed on:
  - Material transfers such as:
    - Unloading of magnetite ore
    - Transferring of ore, pellets, and briquettes
    - Stacking and reclaiming from stockpiles
  - Wind erosion from uncovered open areas.
- Sheds are planned for the ore, limestone and bentonite stockpiles which will suppress any wind erosion emissions and mitigate emissions from material transfer activities
- No shed is planned to cover the HBI stockpile

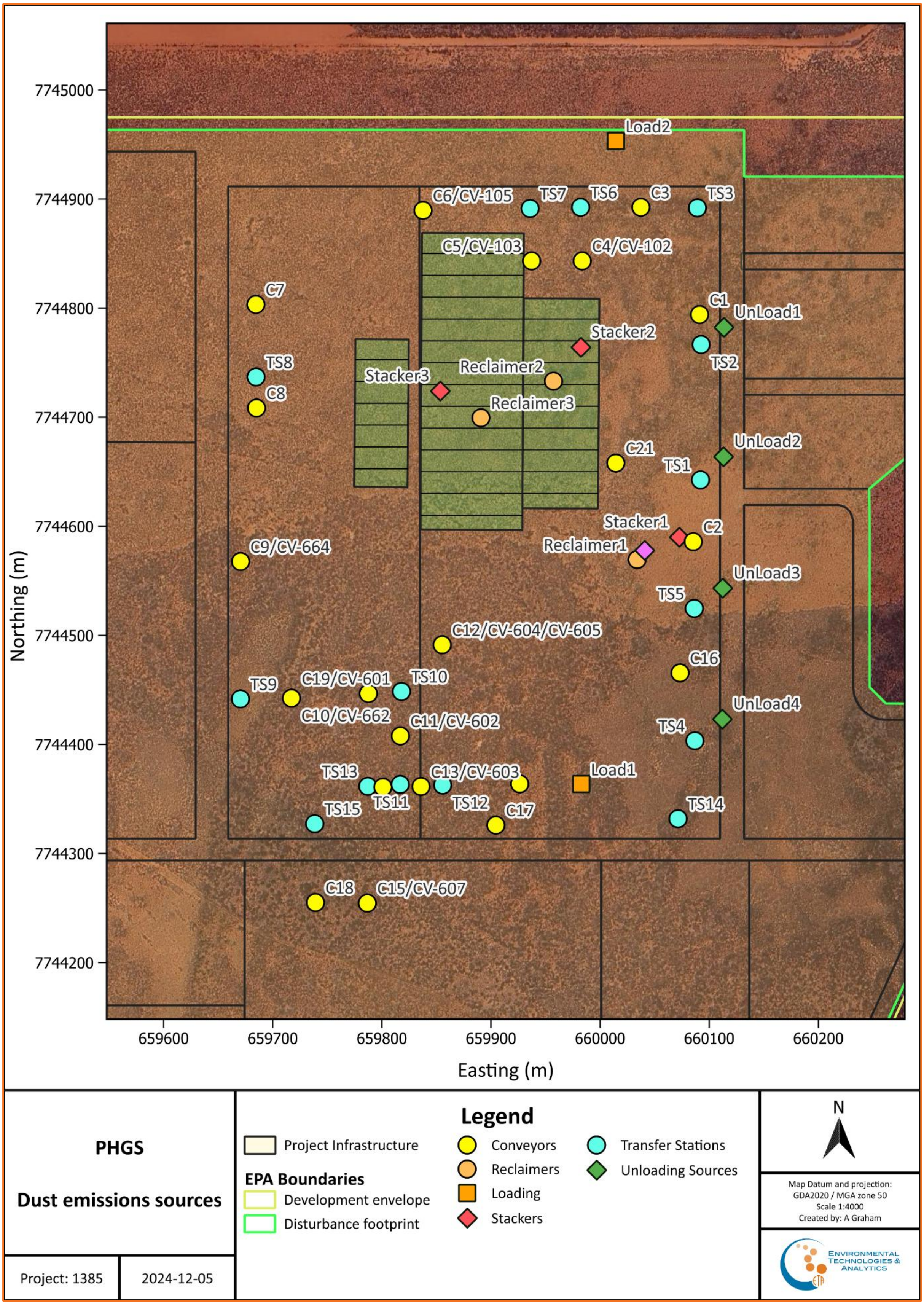

Figure 3-1: Location of dust emissions sources at the Project.

3.2 Emission estimates

This section outlines the emission estimation process for the Project. Emission estimates are sourced from this inventory for inclusion in the dispersion model. It includes the emissions from mine operations, facilities and associated infrastructure including the road network. Emissions from all key sources have been identified according to accepted methods. The emphasis of the emission estimation and modelling is on the potential impact from the operating phase of the various operations within the Project. Emission estimation of construction activities is excluded from the assessment due to their intermittent nature over the life of the Project.

3.2.1 Unloading ore

Emissions for unloading ore from trucks into the operations have been calculated using the default values of:

- PM_{10}: 0.0043 kg/t

The statistics of the annual emissions for loading for PM_{10} are contained in Appendix C.

3.2.2 Handling and transferring

The emissions for the handling and transferring, including stacking and reclaiming, were determined using the default emission factors for high moisture content ores from Table 3 of the Emission Estimation Technique Manual (EETM) for Mining (EA, 2012).

The statistics of the annual emissions for handling and transferring for PM_{10} are contained in Appendix C.

3.2.3 Loading ore

Emissions for loading ore have been calculated using the default value for excavators and front end loaders on overburden of:

- PM_{10}: 0.012 kg/t

The statistics of the annual emissions for loading for PM_{10} are contained in Appendix C.

3.2.4 Wind erosion

The default emission factor for wind erosion in the EETM for Mining (EA, 2012) is a constant emission of 0.2 kg/ha/hr which, while potentially suitable for the calculation of annual emissions, is not suitable for inclusion in atmospheric modelling. This assessment used the modified Shao equation outlined in SKM (2005) which is represented as Equation 3:

Equation 1:

$$\boldsymbol{PM_{10_{(g/m^2/s)}}} = \boldsymbol{k} \times \left\{\boldsymbol{WS^3} \times \left(\boldsymbol{1} - \left(\boldsymbol{WS_0}^{\boldsymbol{2}}/\boldsymbol{WS^2}\right)\right)\right\} \qquad WS > WS_0$$

$$\boldsymbol{PM_{10_{(g/m^2/s)}}} = 0 \qquad WS < WS_0$$

Where: WS = wind speed (m/s)
WS_0 = threshold for particulate matter lift off (m/s)
K is a constant

3.3 Emission Controls

Emissions controls (for dust abatement) were included in the emissions estimation and these controls are summarised in Table 3-1, along with the percentage reduction applied to each source type. Of note is that:

- The proposed sheds covering the limestone and bentonite stockpiles have a potential 100% reduction, while an extraction fan into a baghouse may be utilised to achieve 100% reduction this information was not finalised so a conservative 90% reduction was applied.
- Water suppression for the HBI product is not an option (due to the potential of spontaneous combustion). Thus loading and open areas sources have no abatement applied.
- Conveyors will be enclosed and thus had a 100% reduction and were not modelled.
- Transfer stations were reported to have a partial enclosure.

Table 3-1: Dust abatement in place (included in model)

Source	Equipment	Dust abatement description	Emission reduction
Material transfers	Loading Pellets/HBI	No reduction	
	Unloading Ore	Partial enclosure with water sprays	80%
	Transfer stations	Partial enclosure	50%
	Stacker HBI Yard	No reduction	
	Reclaimer HBI Yard	No reduction	
	Stackers	Enclosed	90%
	Reclaimers	Enclosed	90%
Open Areas	Wind erosion at HBI Yard	No reduction	

3.3.1 Emission summary

The emissions for the Project scenario is presented in Table 3-2. The majority of emissions come from the loading of product and transfer stations.

Table 3-2: Total estimated emissions for modelled scenarios

Scenario	Estimated Emissions (kg/yr)
Unloading Ore	11,410
Loading Pellets/HBI	129,500
Reclaimers	16,170
Stackers	16,170
Transfer stations	125,160
Open Areas	4,930
Total Emissions	**291,930**

3.4 Cumulative Scenario

The modelling of cumulative emissions is a requirement of DWER (DoE, 2006). The cumulative emission sources for this study include both the current and planned export operations in the Port Hedland region including:

- 330 Mtpa from the BHP operations at Nelson Point and Finucane Island.
- 28 Mtpa from the PPA operations at Utah Point.
- 210 Mtpa from the Fortescue operations.
- 50 Mtpa from the proposed NWI operations.
- 70 Mtpa from the Roy Hill facility.

Emissions for existing and planned operations with the Port Hedland airshed were obtained from PHIC and the full emission estimation process is outlined in the PEL (2015) report.

4 Predicted air quality impact

As outlined in Section 2.1 this assessment utilised the PHIC CAM to determine the potential impact associated with the proposed increase in handled tonnage through the Company Port operations. The modelling focus is on particulates, primarily as PM_{10}, and this section outlines the results.

For this assessment, a single scenario of 3.5Mtpa ore in-take at the Project were modelled. This was then compared to the existing PHIC network scenario. The specific scenarios considered were:

- Scenario 1: Base Case – Existing and approved PHIC Operations (as per Section 3.4) with background.
- Scenario 2: The Project standalone without background.
- Scenario 3: Cumulative operations (the Project, BHP, Fortescue, PPA , Roy Hill, and NWI) with background.

4.1 Scenario 1: Base Case

4.1.1 PM_{10}

The predicted ground level concentrations at three receptors; Taplin St, Wedgefield, and South Hedland for Scenario 1 (existing and approved PHIC operations) are presented in Table 4-1. The predicted results at all receptors in the region are contained in Appendix D.

Table 4-1: Predicted 24-hour average ground level concentrations of PM_{10} at Receptors for Scenario 1 with background (µg/m^3)

Statistic	Taplin St.	Neptune Pl.	South Hedland
Maximum	200	193	187
99th percentile	74	99	61
95th percentile	57	72	46
90th percentile	51	63	39
75th percentile	43	48	30
Average	34.3	37.5	25.5
Count >70 µg/m^3	7	22	1

The isopleths for the cumulative predicted maximum PM_{10} 24-hour concentrations for Scenario 1 are presented in Figure 4-1 and the annual average concentrations are presented in Figure 4-2. Noting that:

- Most maximum predicted daily average PM_{10} values occurred on the same date, 14th of December 2013, where the background concentration was 182 µg/m^3.
  - As a result, the features in the contour plot largely reflect the modelled dust characteristics on a single date.

- The contour plot indicates that industry emissions are concentrated over the western side of the harbour with significant emissions over Port Hedland. Noting that maximum daily average emissions may look different without background.

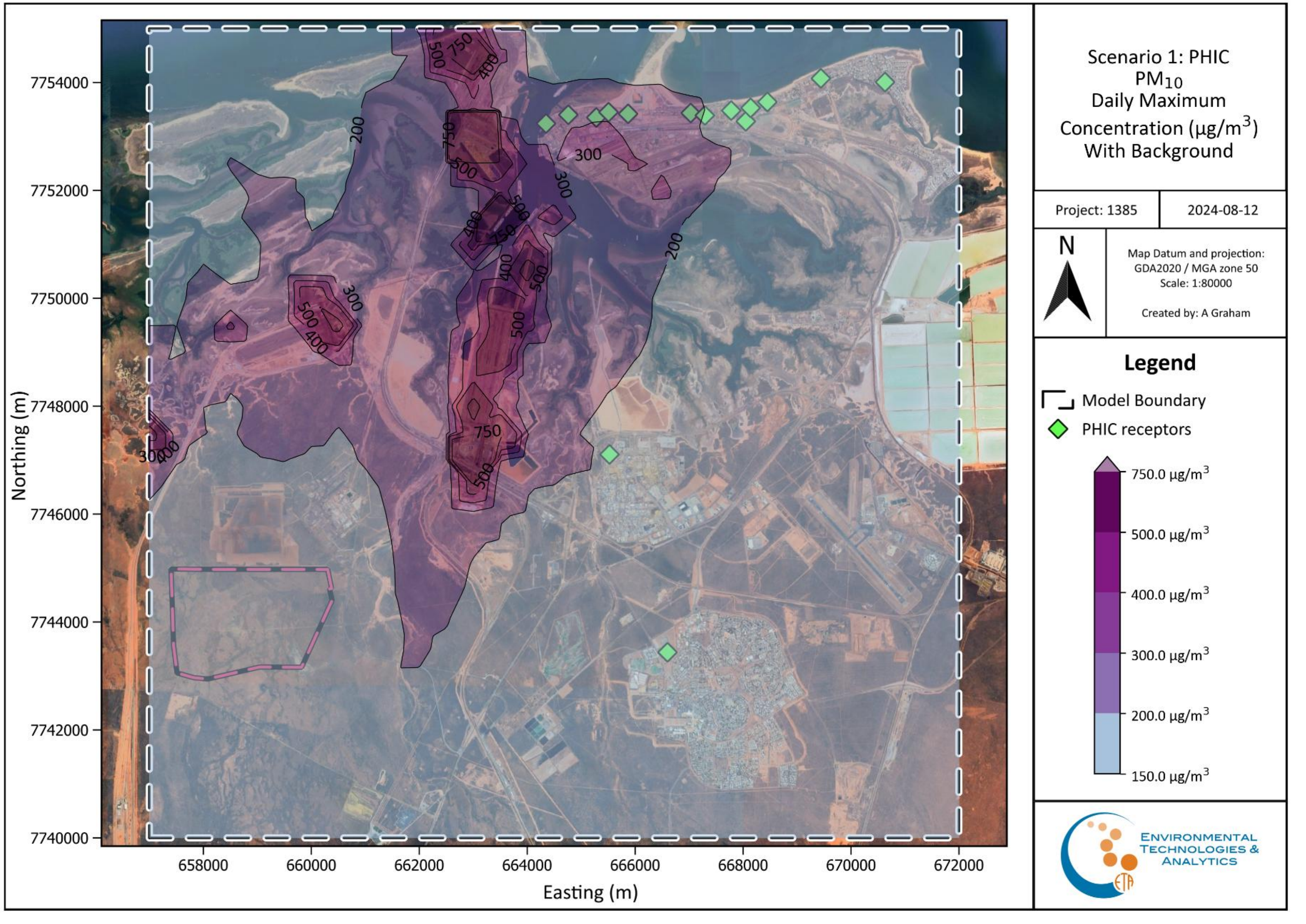

Figure 4-1: Maximum 24-hour PM_{10} concentrations for PHIC existing and cumulative model

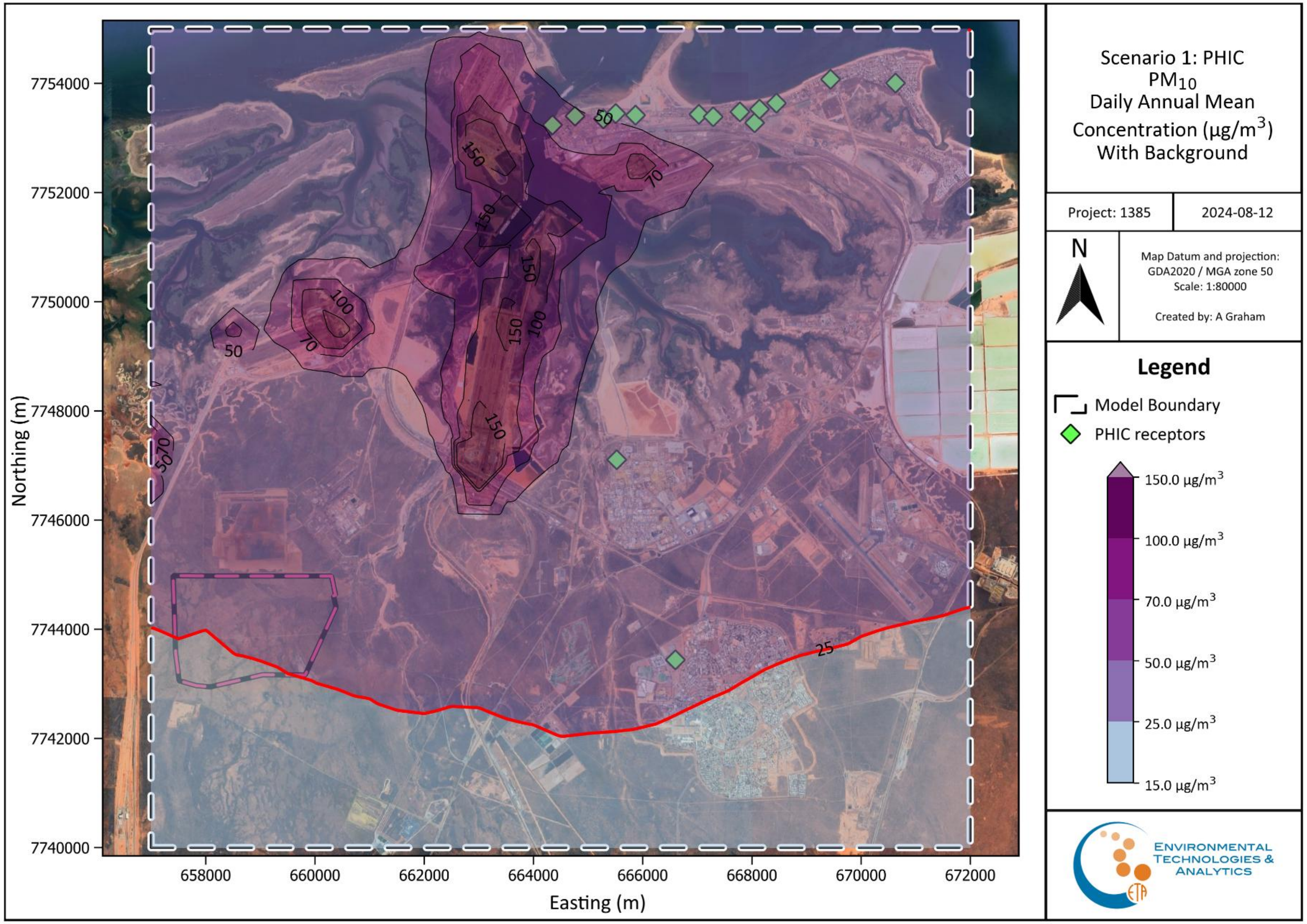

Figure 4-2: Annual average PM_{10} concentrations for PHIC existing and cumulative model

4.1.2 $PM_{2.5}$

The predicted ground level concentrations for $PM_{2.5}$ at three receptors; Taplin St, Wedgefield, and South Hedland for Scenario 1 (existing and approved PHIC operations) are presented in Table 4-2. Note that as discussed in Section 2.6 these results were determined by scaling down the PM_{10} concentrations and should only be considered as indicative.

The predicted results at all receptors in the region are contained in Appendix E.

Table 4-2: Predicted 24-hour average ground level concentrations of $PM_{2.5}$ at Receptors for Scenario 1 with background (µg/m³)

Statistic	Taplin St.	Neptune Pl.	South Hedland
Maximum	40	39	37
99th percentile	15	12	12
95th percentile	11	9	9
90th percentile	10	8	8
75th percentile	8	7	6
Average	6.9	5.5	5.1
Count >25 µg/m³	1	1	1

The isopleths for the cumulative predicted maximum $PM_{2.5}$ 24-hour concentrations for Scenario 1 are presented in Figure 4-3 and the cumulative predicted annual average $PM_{2.5}$ concentrations are presented in Figure 4-4. Noting that:

- These results were determined by scaling down the PM_{10} concentrations and should only be considered as indicative.
- As with the PM_{10} concentrations these results are influenced by a single elevated background concentration which occurred on the 14th of December 2013. As a result, the features in the contour plot largely reflect the modelled dust characteristics on a single date.
- The contour plot indicates that industry emissions are concentrated over the western side of the harbour with significant emissions over Port Hedland. Noting that maximum daily average emissions may look different without background.

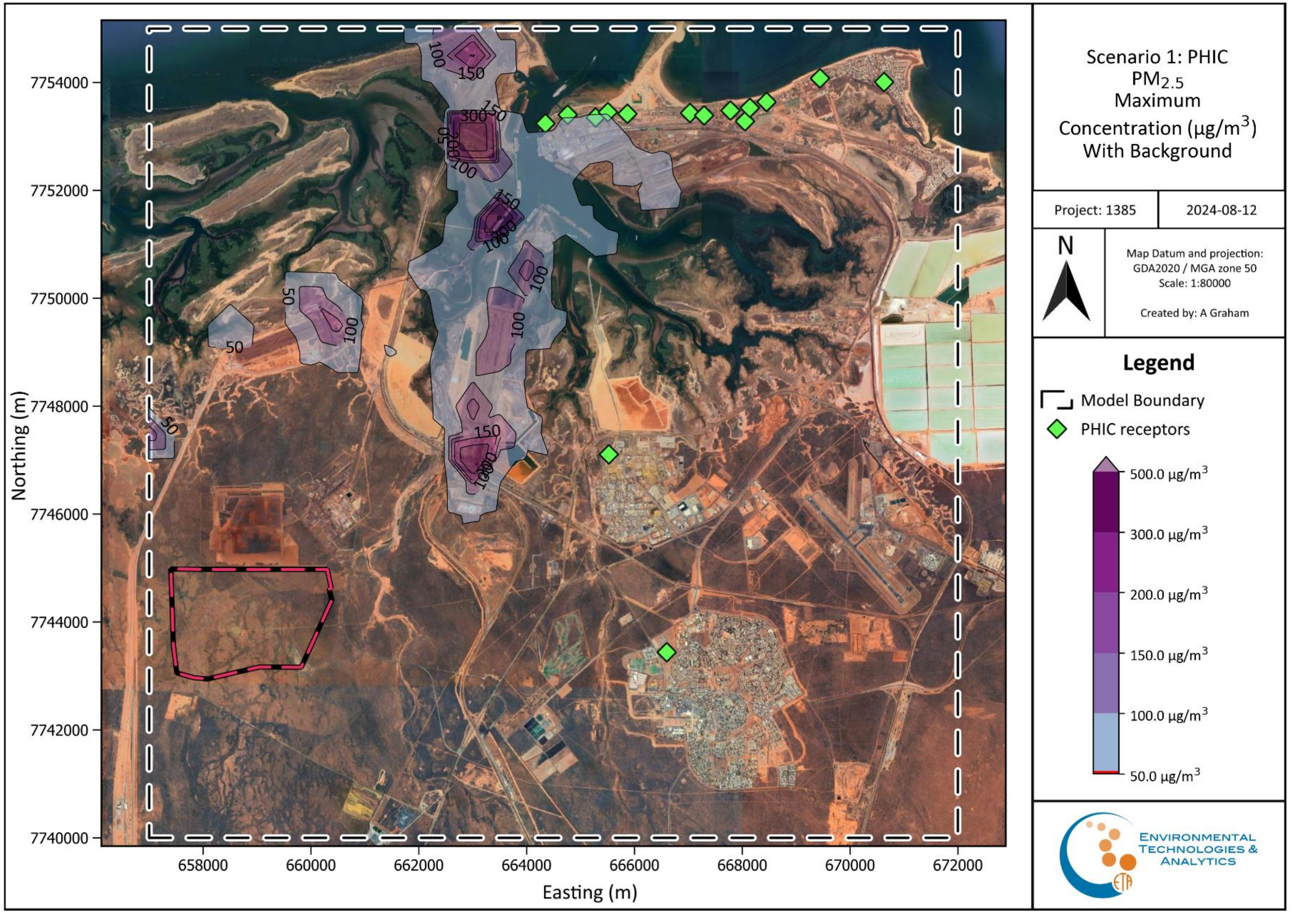

Figure 4-3: Indicative maximum 24-hour $PM_{2.5}$ concentrations for PHIC existing and cumulative model

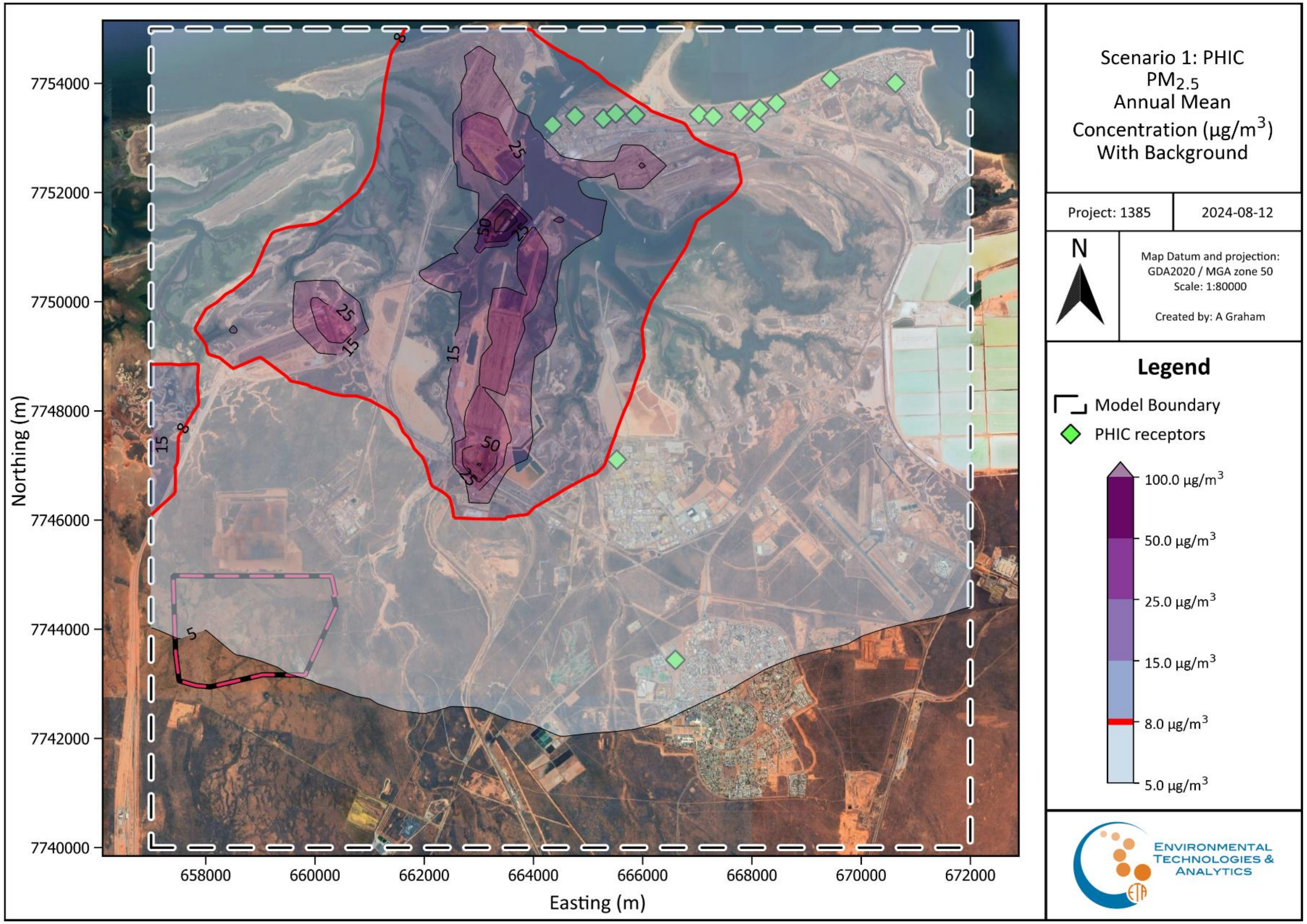

Figure 4-4: Indicative annual average $PM_{2.5}$ concentrations for PHIC existing and cumulative model

4.2 Scenario 2: Port Hedland Green Steel only

4.2.1 PM_{10}

The predicted ground level concentrations at three receptors; Taplin St, Neptune Pl, and South Hedland for Scenario 2 (conceptual South West Creek) are presented in Table 4-3. The predicted results at all receptors in the region are contained in Appendix D. These results indicate that:

- At the Taplin St receptor all of the predicted 24-hour averaged PM_{10} concentrations are below 1 µg/m^3.
- The highest predicted impact will be 3.2 µg/m^3 at the South Hedland receptor, with the lower percentile results being significantly lower.

Table 4-3: Predicted 24-hour ground level concentrations of PM_{10} at Receptors for Scenario 2 (µg/m^3)

Statistic	Taplin St.	Neptune Pl.	South Hedland
Maximum	0.8	1.9	3.2
99th percentile	0.5	1.4	2.3
95th percentile	0.3	1.0	1.6
90th percentile	0.2	0.7	1.1
75th percentile	0.1	0.4	0.4
Average	0.07	0.25	0.33
Count >70 µg/m^3	0	0	0

The isopleths for the cumulative predicted maximum PM_{10} 24-hour concentrations for Scenario 2 are presented in Figure 4-5 with the annual average PM_{10} concentrations presented in Figure 4-6.

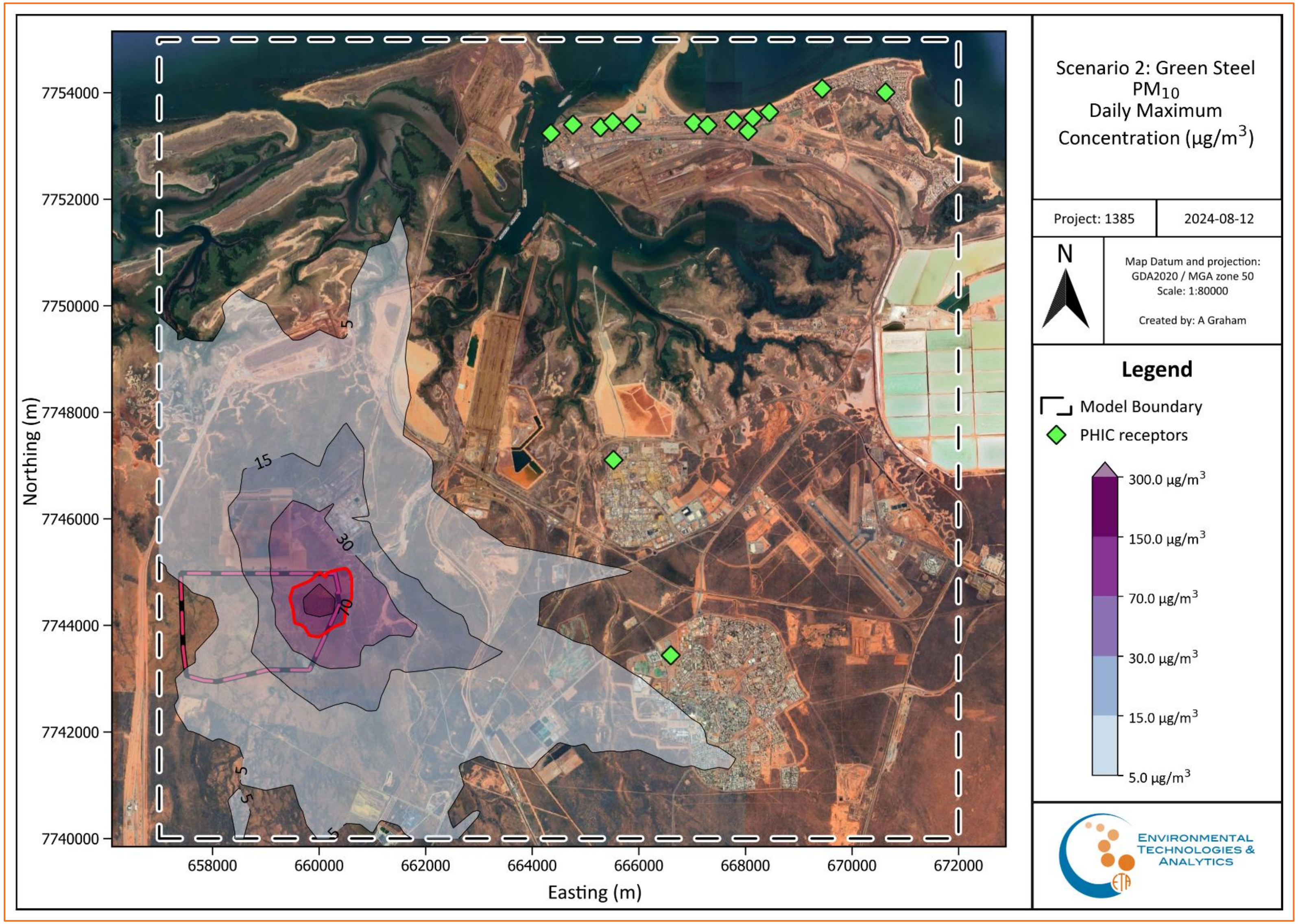

Figure 4-5: Maximum 24-hour PM_{10} concentrations for Scenario 2: the Project (µg/m³)

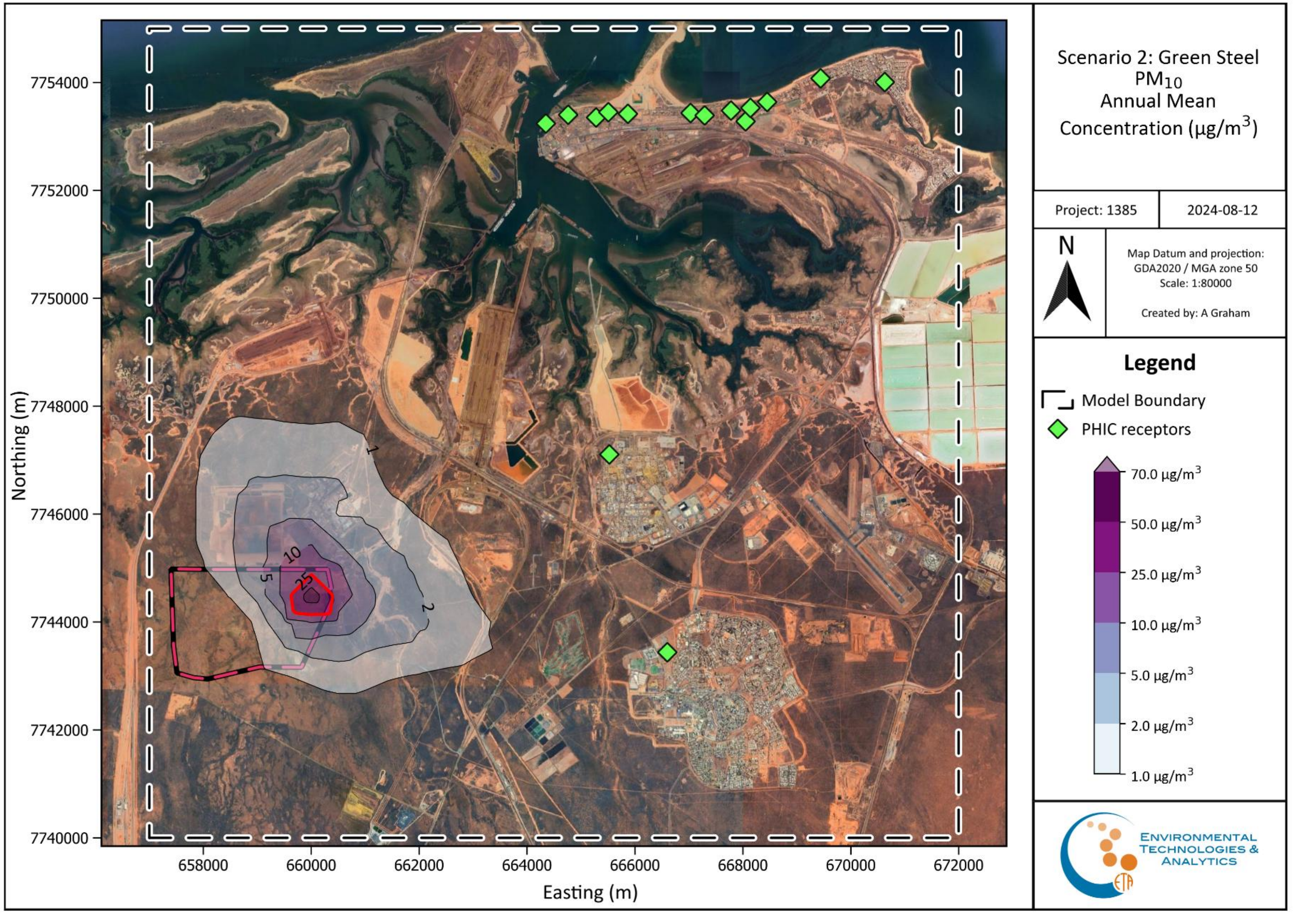

Figure 4-6: Annual average PM_{10} concentrations for Scenario 2: the Project (µg/m^3)

4.2.2 $PM_{2.5}$

The predicted ground level concentrations at three receptors; Taplin St, Wedgefield, and South Hedland for Scenario 2 (the Project) are presented in Table 4-4. These results indicate that:

- At the Taplin St receptor all of the predicted 24-hour averaged $PM_{2.5}$ concentrations are well below 1 µg/m^3.
- The highest predicted impact will be 0.64 µg/m^3 at the South Hedland receptor, with the lower percentile results being significantly lower.

The predicted results at all receptors in the region are contained in Appendix E.

Table 4-4: Predicted 24-hour average ground level concentrations of $PM_{2.5}$ at Receptors for Scenario 2 without background (µg/m^3)

Statistic	Taplin St.	Neptune Pl.	South Hedland
Maximum	0.17	0.14	0.64
99th percentile	0.10	0.08	0.45
95th percentile	0.06	0.05	0.31
90th percentile	0.05	0.03	0.22
75th percentile	0.02	0.01	0.08
Average	0.01	0.01	0.07
Count >25 µg/m^3	0	0	0

The isopleths for the cumulative predicted maximum $PM_{2.5}$ 24-hour concentrations for Scenario 2 are presented in Figure 4-7 and the cumulative predicted annual average $PM_{2.5}$ concentrations are presented in Figure 4-8. Noting that:

- These results were determined by scaling down the PM_{10} concentrations and should only be considered as indicative.

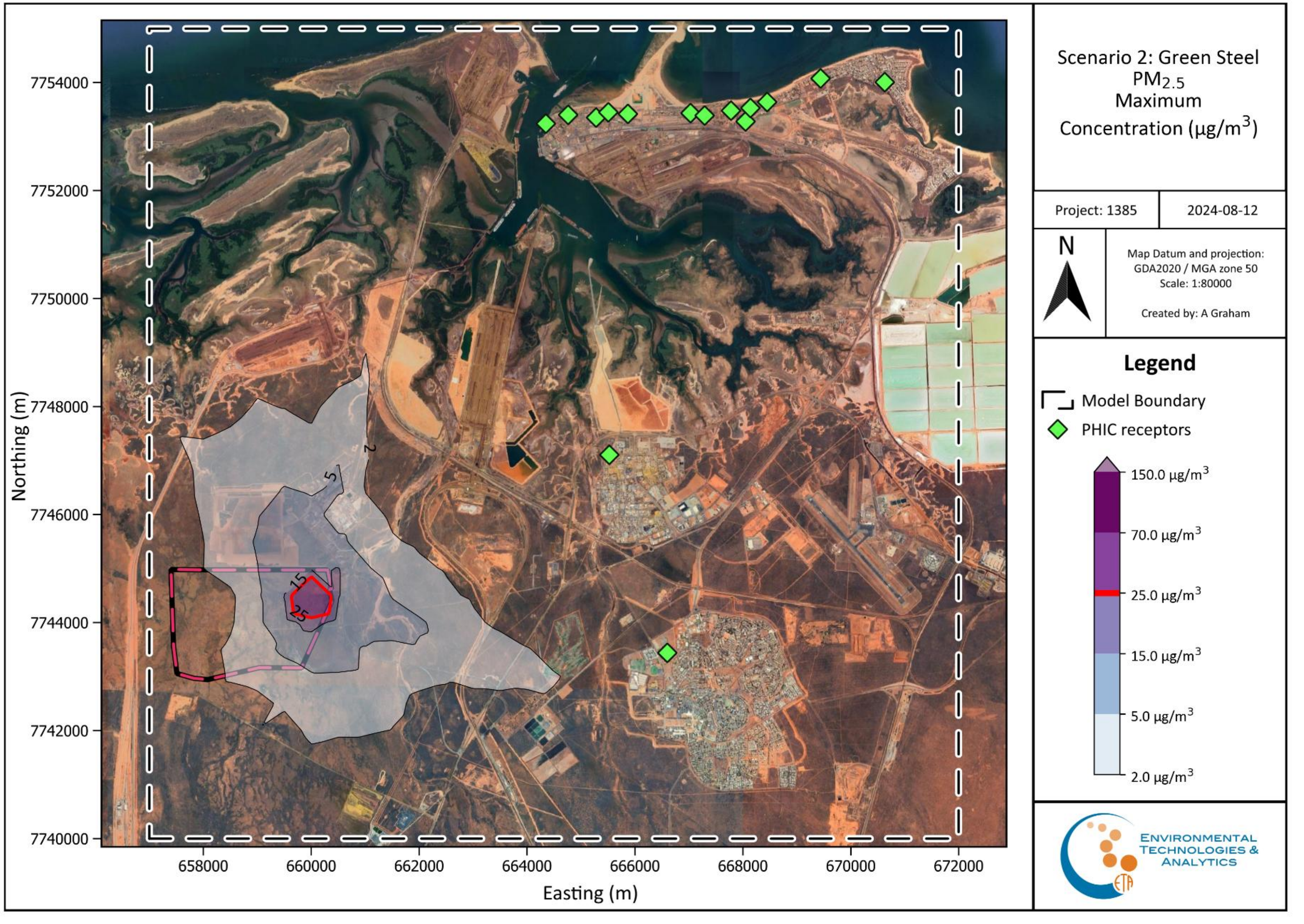

Figure 4-7: Indicative maximum 24-hour $PM_{2.5}$ concentrations for Scenario 2: the Project (µg/m³)

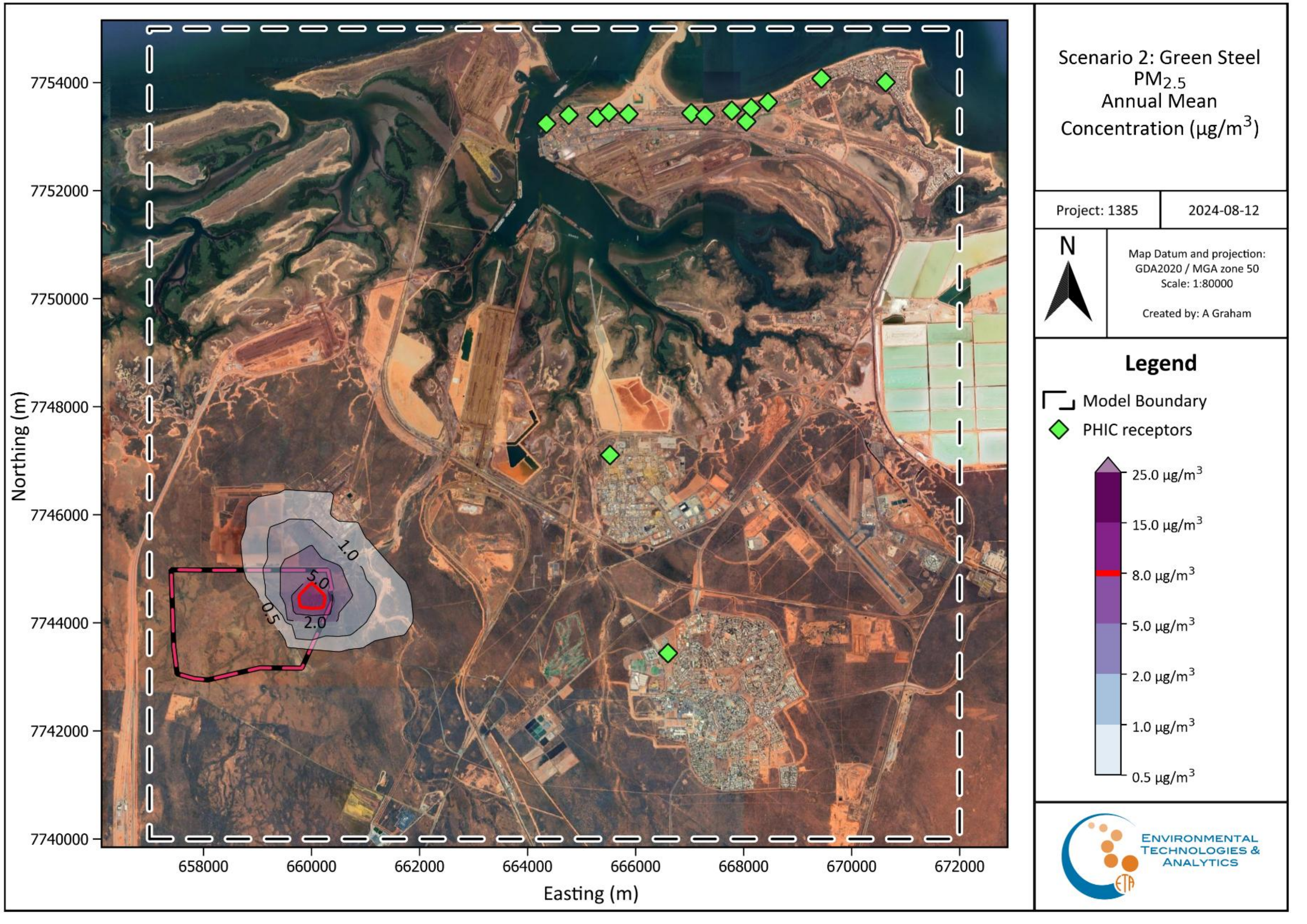

Figure 4-8: Indicative annual average $PM_{2.5}$ concentrations for Scenario 2: the Project (µg/m³)

4.3 Scenario 3: Cumulative Operations

The final scenario presented (Scenario 3) combines the existing and approved facilities with background (Scenario 1) and the modelled Project impact (Scenario 2) to evaluate the cumulative effect of the Project in the broader context of Port Hedland.

4.3.1 PM_{10}

The predicted ground level concentrations at three receptors; Taplin St, Wedgefield, and South Hedland for this scenario are presented in Table 4-5. Of note is that:

- There is no predicted change to the number of excursion of the criteria at the Taplin St receptor
- There is no predicted change to the maximum predicted 24-hour PM_{10} concentration at the Taplin St receptor.
- There are no predicted changes to the maximum predicted 24-hour PM_{10} concentration at either the Wedgefield or South Hedland receptors.

The predicted results at all receptors in the region are contained in Appendix D.

Table 4-5: Predicted 24-hour ground level concentrations of PM_{10} at Receptors for Scenario 3 ($\mu g/m^3$) with background

Statistic	Taplin St.	Neptune Pl.	South Hedland
Maximum	200	194	187
99th percentile	74	99	62
95th percentile	57	72	47
90th percentile	51	63	39
75th percentile	43	49	30
Average	34.4	37.8	25.8
Count >70 $\mu g/m^3$	7	23	1

The isopleths for the cumulative predicted maximum PM_{10} 24-hour concentrations for Scenario 3 are presented in Figure 4-9 while those for the predicted annual average PM_{10} concentrations are presented in Figure 4-10.

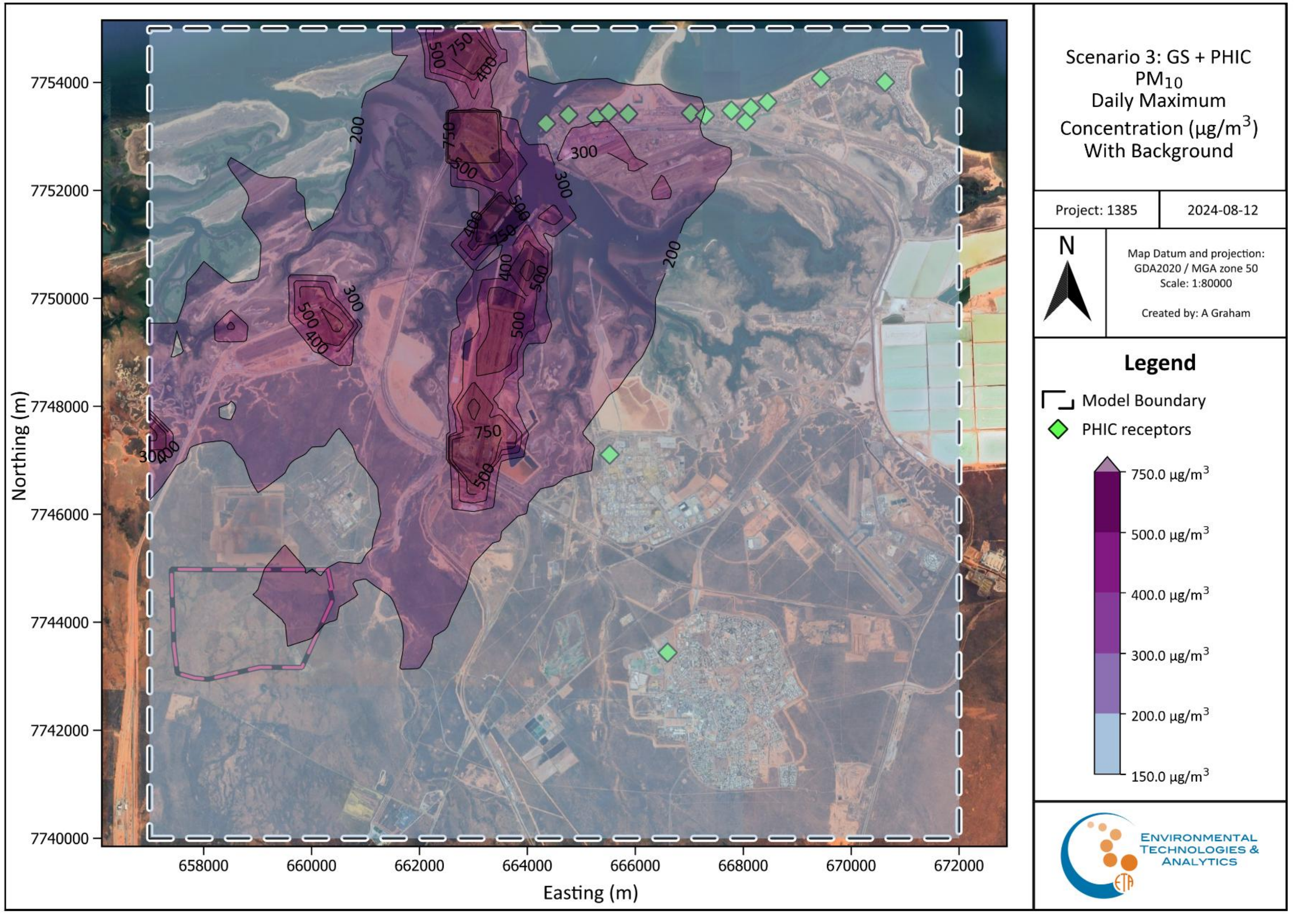

Figure 4-9: Maximum 24-hour PM_{10} concentrations for Scenario 3: PHGS + PHIC (µg/m³)

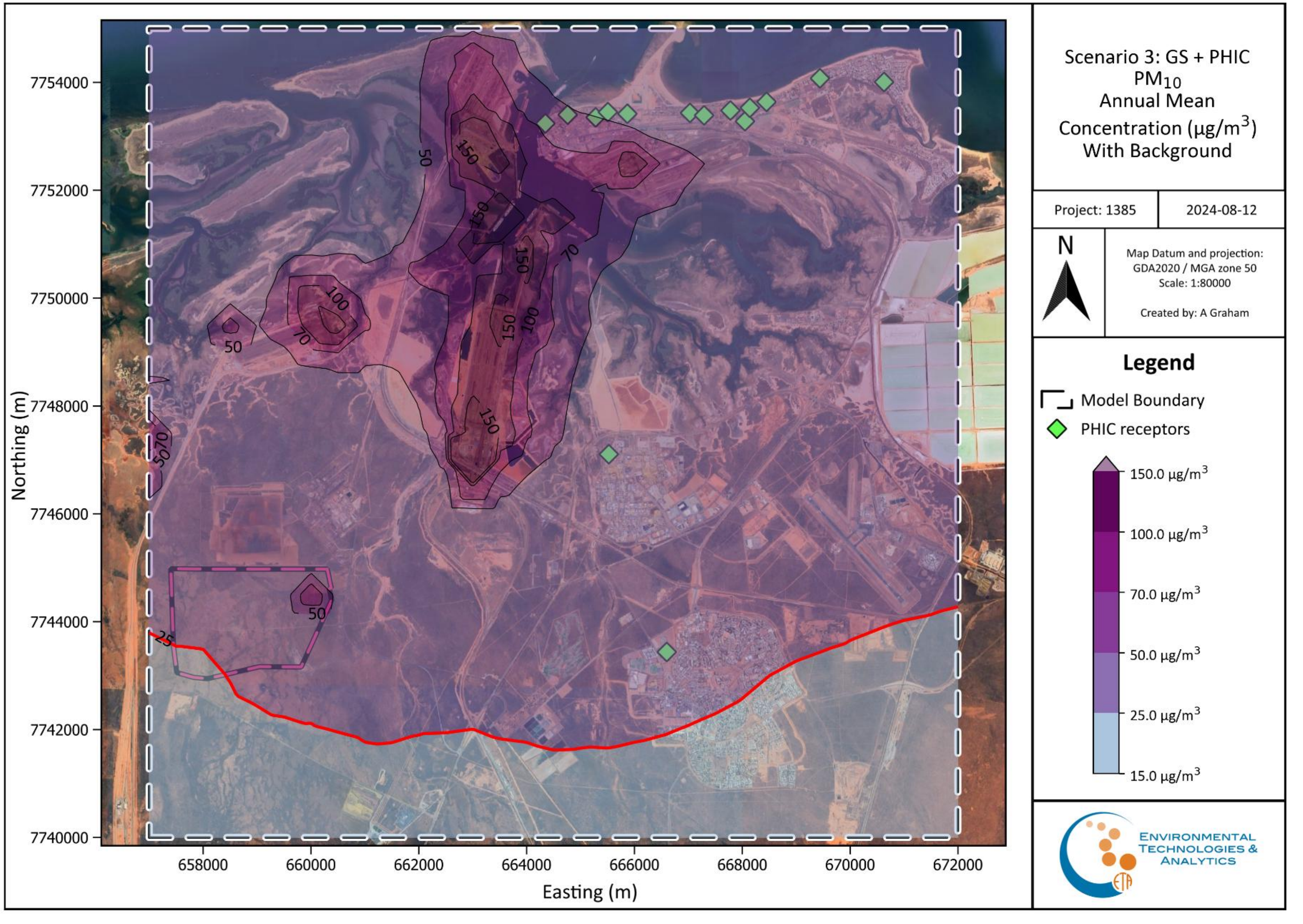

Figure 4-10: Annual average PM_{10} concentrations for Scenario 3: PHGS + PHIC (µg/m³)

4.3.2 $PM_{2.5}$

The predicted ground level concentrations for $PM_{2.5}$ at three receptors; Taplin St, Wedgefield, and South Hedland for Scenario 3 (existing and approved PHIC operations plus the Project) are presented in Table 4-6. Of note is that:

- There is no predicted change to the number of excursion of the criteria at the Taplin St receptor
- There is no predicted change to the maximum predicted 24-hour $PM_{2.5}$ concentration at the Taplin St receptor.
- There are no predicted changes to the maximum predicted 24-hour $PM_{2.5}$ concentration at either the Wedgefield or South Hedland receptors.

The predicted results at all receptors in the region are contained in Appendix E.

Table 4-6: Predicted 24-hour average ground level concentrations of $PM_{2.5}$ at Receptors for Scenario 3 with background (µg/m³)

Statistic	Taplin St.	Neptune Pl.	South Hedland
Maximum	40	39	37
99th percentile	15	12	12
95th percentile	11	9	9
90th percentile	10	8	8
75th percentile	9	7	6
Average	6.9	5.5	5.2
Count >25 µg/m³	1	1	1

The isopleths for the cumulative predicted maximum $PM_{2.5}$ 24-hour concentrations for Scenario 3 are presented in Figure 4-11 and the cumulative predicted annual average $PM_{2.5}$ concentrations are presented in Figure 4-12. Noting that:

- These results were determined by scaling down the PM_{10} concentrations and should only be considered as indicative.
- As with the PM_{10} concentrations these results are influenced by a single elevated background concentration which occurred on the 14th of December 2013. As a result, the features in the contour plot largely reflect the modelled dust characteristics on a single date.

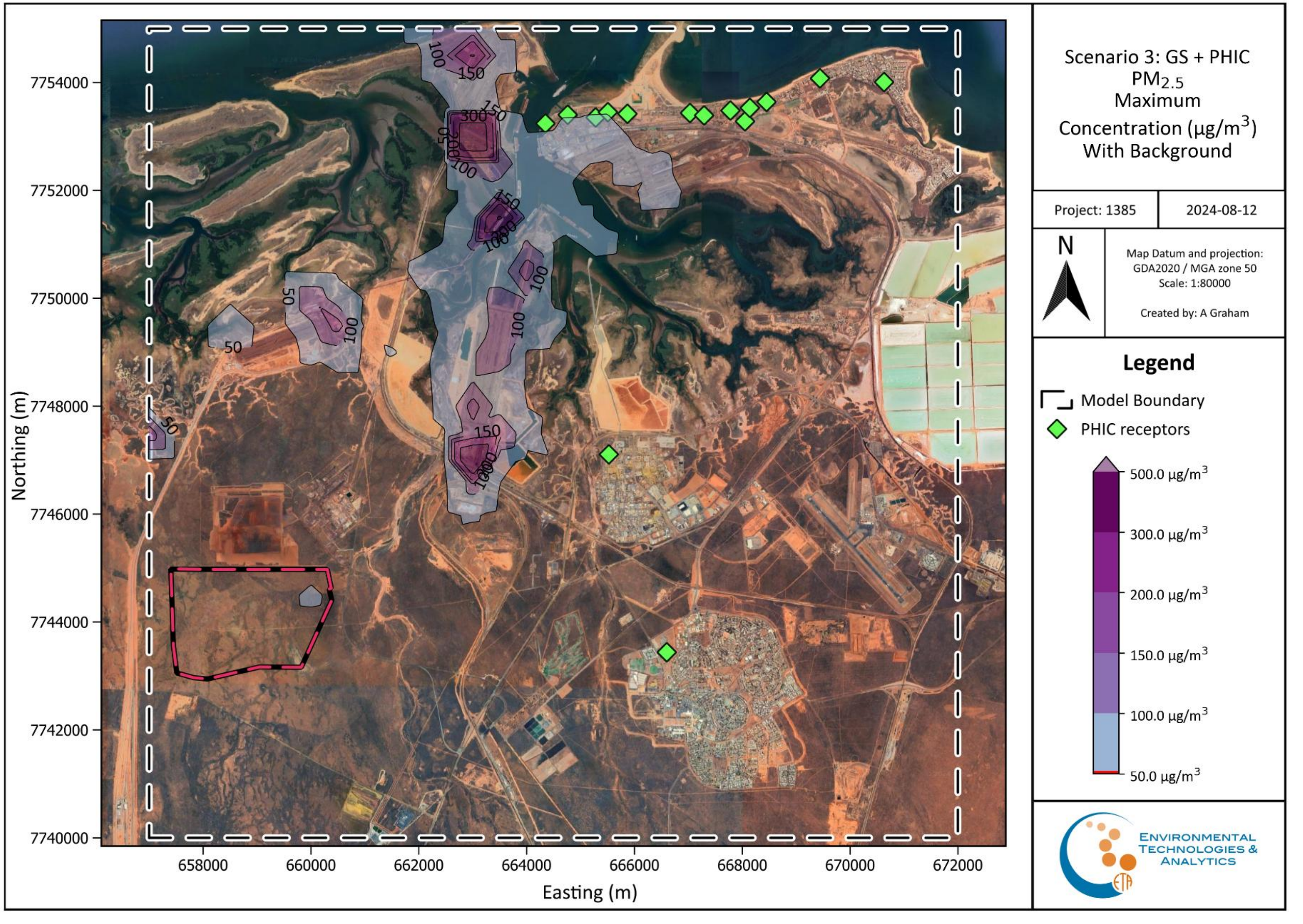

Figure 4-11: Indicative maximum 24-hour $PM_{2.5}$ concentrations for PHIC existing and cumulative model

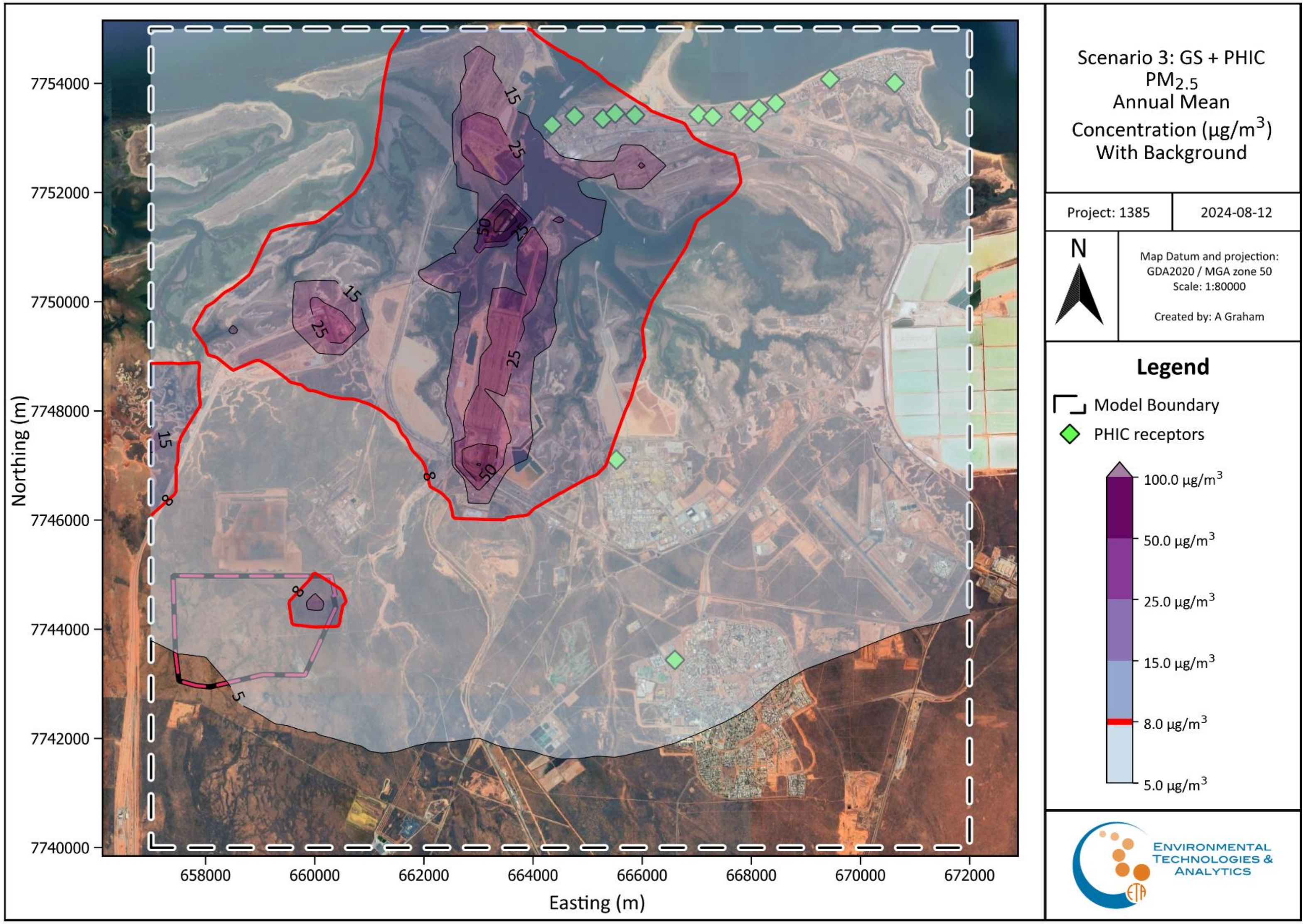

Figure 4-12: Indicative annual average $PM_{2.5}$ concentrations for PHIC existing and cumulative model

4.4 Comparison at Taplin St

For comparison purposes the predicted ground level concentrations at the Taplin St receptor are presented for each scenario in Table 4-7. At Taplin St:

- The Project activities are modelled to predict a maximum increase of 0.8 µg/m^3.
- There is no predicted change to the number of excursion of the criteria at the Taplin St receptor
- There is no predicted change to the maximum predicted 24-hour PM_{10} concentration at the Taplin St receptor.
- There are no predicted changes to the maximum predicted 24-hour PM_{10} concentration at either the Wedgefield or South Hedland receptors.

Table 4-7: Predicted 24-hour ground level concentrations of PM_{10} at Taplin St for the Project – 3.5 Mtpa

Statistic	Scenario 1	Scenario 2	Scenario 3
Maximum	200	0.8	200
99th percentile	74	0.5	74
95th percentile	57	0.3	57
90th percentile	51	0.2	51
75th percentile	43	0.1	43
Average	34.3	0.07	34.4
Count >70 µg/m3	7	0	7

5 Conclusions

Port Hedland Green Steel Pty Ltd is evaluating the feasibility of developing a large-scale downstream processing capability at the Boodarie Strategic Industrial Area (BSIA) in Port Hedland, Western Australia. This development, the Australia Green Steel Project (the Project), will source magnetite concentrate from iron ore operations in the Pilbara to produce Hot Briquetted Iron (HBI) for export to customers who will convert the HBI into a low carbon emission steel overseas.

The Project will be developed in stages, with Stage 1 consisting of developing the Iron Ore Processing Facility consisting of a Pellet Plant which will consume approximately 3 - 3.5 million tonnes per annum (Mtpa) of iron ore (trucked in from iron ore operations in the Pilbara) and a HBI Plant which will further process approximately 2 Mtpa of the pellets into HBI.

The scenarios considered are:

- Scenario 1: Base case, PHIC network emissions with background (not including the Project)
- Scenario 2: The Project without background
- Scenario 3: Cumulative model of PHIC and the Project with background.

Of which, modelling was required for Scenario 2 emissions which were then integrated with existing modelling for Scenario 3.

Modelling was undertaken using the atmospheric dispersion AERMOD configured in accordance with the work undertaken as part of the PHIC CAM including meteorology, receptors, background concentrations and existing and approved operations in the region.

The results of the modelling, at selected receptors, predict for the:

- Standalone scenario (i.e. The Project in isolation of other emission sources and no background):
  - For PM_{10}:
    - At the Taplin St receptor all of the predicted 24-hour averaged PM_{10} concentrations are below 1 µg/m^3.
    - The highest predicted impact will be 3.2 µg/m^3 at the South Hedland receptor, with the lower percentile results being significantly lower.
  - For $PM_{2.5}$:
    - At the Taplin St receptor all of the predicted 24-hour averaged $PM_{2.5}$ concentrations are well below 1 µg/m^3.
    - The highest predicted impact will be 0.64 µg/m^3 at the South Hedland receptor, with the lower percentile results being significantly lower.
- Scenario 3 which is a cumulative model of the PHIC network including the Project and with background, for both PM_{10} and $PM_{2.5}$:
  - There is no predicted change to the number of excursion of the criteria at the Taplin St receptor
  - There is no predicted change to the maximum predicted 24-hour concentration at the Taplin St receptor.
  - There are no predicted changes to the maximum predicted 24-hour concentration at either the Wedgefield or South Hedland receptors.

6 References

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7 Acronyms and Glossary

Acronym	Description
BWS	Belt wash station
CAM	Cumulative Air Model
CVR	Conveyor
DWER	Department of Water and Environmental Regulation
EE	Emissions estimation
EETM	Emissions Estimation Technique Manual
EF	Emission factor
EPAV	Environmental Protection Authority Victoria, Australia
ETA	Environmental Technologies& Analytics Pty Ltd
FEL	Front end loader
Fortescue	Fortescue Metals Group
GLC	Ground Level Concentration
g/s	grams per second
h/yr	Hours per year
kg	kilogram
kg/t	kilogram per tonne
kg/yr	kilograms per year
km	kilometre
m	metre
m/s	metres per second
mm	millimetre
MRL	Mineral Resources Limited

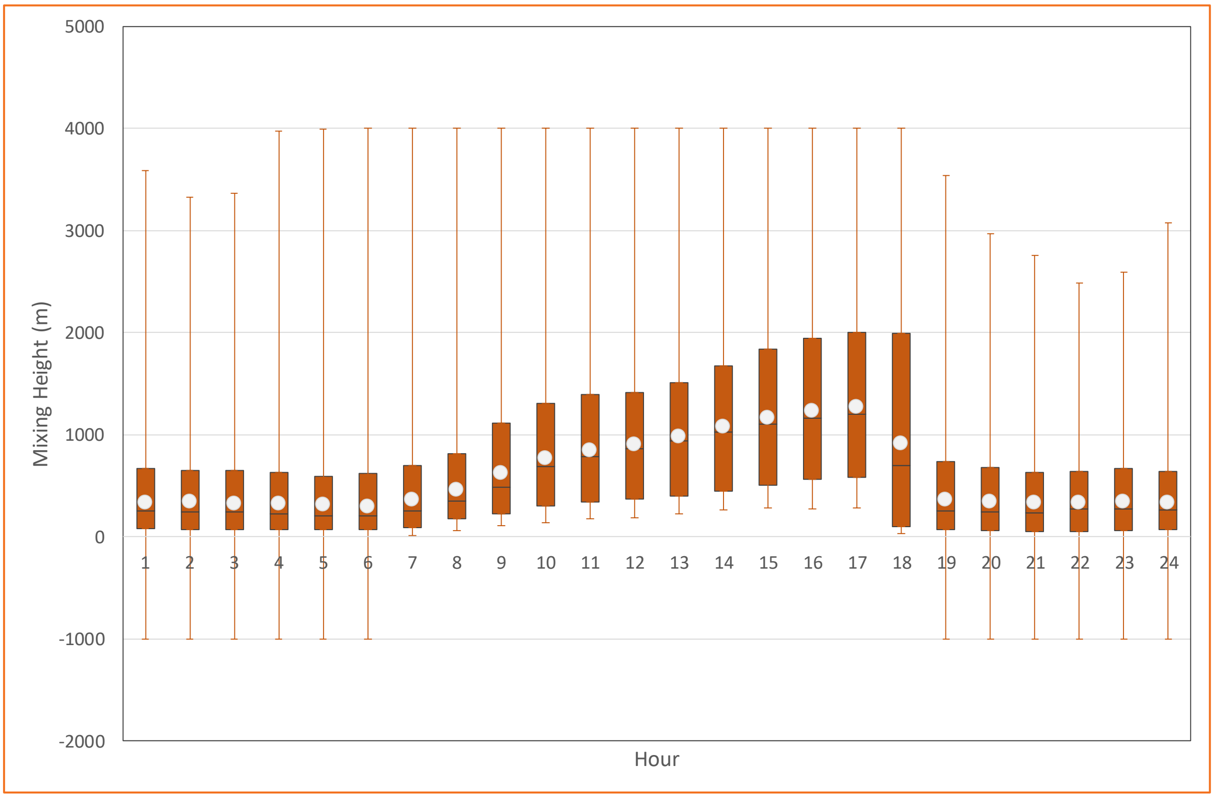
Acronym	Description
Mt	Million tonnes
Mtpa	Million tonnes per annum
NEPM	National Environmental Protection Measure
NPI	National Pollutant Inventory
NSW	New South Wales
NWI	North West Infrastructure
PHIC	Port Hedland Industries Council
PM	Particulate matter, small particles and liquid droplets that can remain suspended in air.
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of 10 µm or less.
PM_{10}	Particulate matter with an aerodynamic diameter of 2.5 µm or less.
PPA	Pilbara Ports Authority
t	Tonnes
t/h	Tonnes per hour
tpa	tonnes per annum
tph	tonnes per hour
TS	Transfer station
TSP	Total suspended particulates
$\mu g/m^3$	micro grams (one millionth of a gram) per cubic metre
µm	micrometre

8 Appendices

Appendix A – PHIC CAM Meteorology

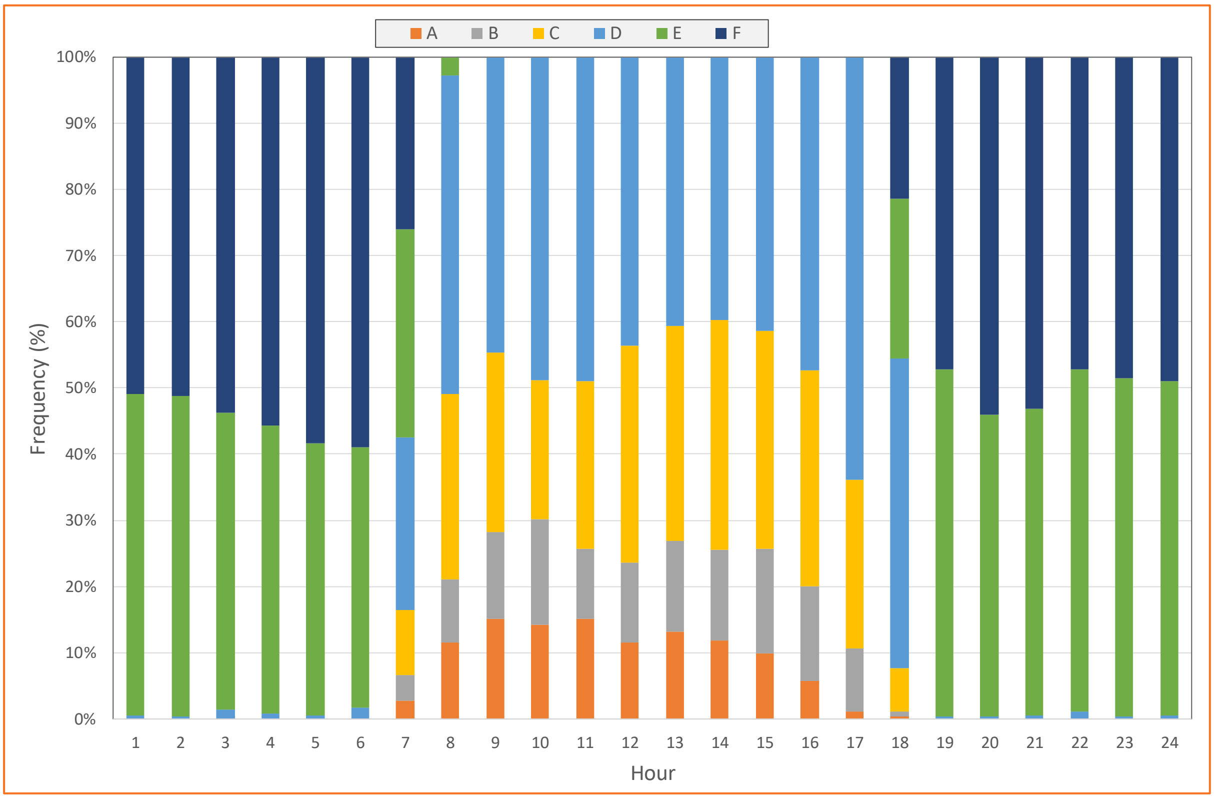
The full details on the meteorological file used in the assessment are contained in the PHIC CAM model comparison report (PEL, 2015). The following sections broadly outline the characteristics of the PHIC CAM meteorological file.

The diurnal statistics of the mixing height are presented in Appendix Figure 1. From this figure it is apparent that there is a gradual increase during the day followed by a marked decline in the average mixing height in the late afternoon. This decrease is due to the transition from convective to mechanical mixing.

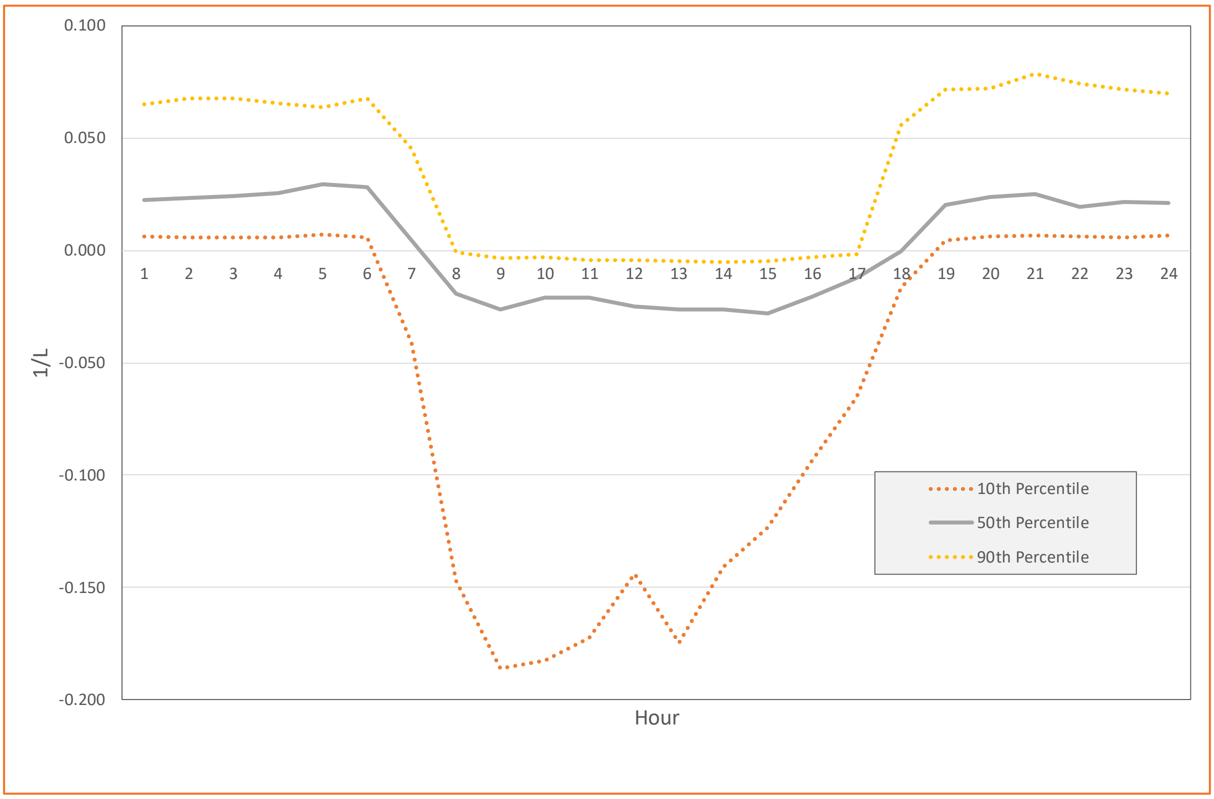


Appendix Figure 1: AERMET mixing height for the PHIC CAM

A plot of the atmospheric stability, by hour of the day, is presented in Appendix Figure 2. The profile shows that neutral (D) and unstable (A – C) atmospheric conditions occur during the daytime, with the night dominated by stable conditions (E – F). This is further confirmed in Appendix Figure 3 which shows the statistics, by hour of the day, of the Monin-Obukhov length.



Appendix Figure 2: Golder plot of stability classes by time of day



Appendix Figure 3: Hourly statistics of the Monin-Obukhov length

Appendix B – Emission Parameters

Appendix Table 1: Emission source parameters

ID	Easting (m)	Northing (m)	Height (m)	Sigma Y (m)	Sigma Z (m)
UnLoad1	660,114	7,744,782	2	3	0.93
UnLoad2	660,113	7,744,664	2	3	0.93
UnLoad3	660,112	7,744,543	2	2	0.93
UnLoad4	660,112	7,744,423	2	12	0.93
TS1	660,092	7,744,642	3	12	1.4
TS2	660,093	7,744,767	3	2	1.4
TS4	660,087	7,744,403	3	70	1.4
TS5	660,086	7,744,525	3	70	1.4
TS3	660,089	7,744,892	3	138	1.4
TS6	659,982	7,744,892	3	137	1.4
TS7	659,936	7,744,891	3	70	1.4
TS8	659,685	7,744,737	3	70	1.4
TS10	659,818	7,744,449	3	2	1.4
TS11	659,817	7,744,363	3	12	1.4
TS13	659,787	7,744,362	3	12	1.4
TS14	660,071	7,744,332	3	2	1.4
TS15	659,738	7,744,327	3	2	1.4
TS9	659,670	7,744,442	3	35	1.4
TS12	659,856	7,744,363	3	35	1.4
Load1	659,983	7,744,364	4	35	2.33
Load2	660,015	7,744,953	4	35	2.33
Stacker1	660,073	7,744,590	8	35	3.72
Reclaimer1	660,034	7,744,569	8	2	3.72
Stacker2	659,982	7,744,764	8	12	3.72
Reclaimer2	659,957	7,744,733	8	12	3.72
Stacker3	659,854	7,744,724	8	25	3.72
Reclaimer3	659,891	7,744,699	8	25	3.72

Appendix Table 2: Wind Erosion Coordinates

Source ID	Eastings				Northings			
	1	2	3	4	1	2	3	4
HBI_Yard	660009	660073	660073	660009	7744610	7744610	7744546	7744546

Appendix Table 3: Wind Erosion Parameters

Source ID	Effective Radius	Effective Ht	Sigma Z
HBI_Yard	35.7	1.5	0.7

Appendix C – Emission Rates

Appendix Table 4: Emission statistics for Scenario 2: The Project (g/s)

ID	Maximum	99th Percentile	95th Percentile	90th Percentile	70th Percentile	Average
Load1	0.71	0.71	0.71	0.71	0.71	0.57
Load2	0.95	0.95	0.95	0.95	0.95	0.76
Reclaimer1	0.16	0.16	0.16	0.16	0.16	0.13
Reclaimer2	0.02	0.02	0.02	0.02	0.02	0.01
Reclaimer3	0.01	0.01	0.01	0.01	0.01	0.01
Stacker1	0.16	0.16	0.16	0.16	0.16	0.13
Stacker2	0.02	0.02	0.02	0.02	0.02	0.01
Stacker3	0.01	0.01	0.01	0.01	0.01	0.01
TS1	0.06	0.06	0.06	0.06	0.06	0.04
TS10	0.22	0.22	0.22	0.22	0.22	0.18
TS11	0.22	0.22	0.22	0.22	0.22	0.18
TS12	0.19	0.19	0.19	0.19	0.19	0.15
TS13	0.13	0.13	0.13	0.13	0.13	0.10
TS14	0.10	0.10	0.10	0.10	0.10	0.08
TS15	0.10	0.10	0.10	0.10	0.10	0.08
TS2	0.06	0.06	0.06	0.06	0.06	0.04
TS3	0.06	0.06	0.06	0.06	0.06	0.04
TS4	0.06	0.06	0.06	0.06	0.06	0.04
TS5	0.06	0.06	0.06	0.06	0.06	0.04
TS6	0.06	0.06	0.06	0.06	0.06	0.04
TS7	0.06	0.06	0.06	0.06	0.06	0.04
TS8	0.06	0.06	0.06	0.06	0.06	0.04
TS9	0.02	0.02	0.02	0.02	0.02	0.02
UnLoad1	0.03	0.03	0.03	0.03	0.03	0.02
UnLoad2	0.03	0.03	0.03	0.03	0.03	0.02
UnLoad3	0.03	0.03	0.03	0.03	0.03	0.02
UnLoad4	0.03	0.03	0.03	0.03	0.03	0.02
HBI_Yard	9.08	1.28	0.27	0.15	0.01	0.078

Appendix D – PM_{10} Model Results

Appendix Table 5: Predicted 24-hour ground level concentrations of PM_{10} for Scenario 1 Base Case, PHIC only, with background (µg/m³)

Source	Harbour	Richardson St	BMX	Kingsmill St	Hospital	Taplin St	St Cecilia's	Holiday Inn	Shop	All Seasons	Council	Neptune Pl	Primary School	South Hedland	Wedgefield
Maximum	217	212	223	222	217	200	198	195	195	194	194	193	192	187	193
99th percentile	134	138	103	96	91	74	70	66	64	65	64	61	59	61	99
95th percentile	106	89	81	79	73	57	56	52	53	51	49	44	42	46	72
90th percentile	89	79	73	68	63	51	49	46	48	45	44	40	38	39	63
75th percentile	73	62	58	56	52	43	42	40	40	39	37	34	33	30	48
Average	60.4	52.6	48.8	45.7	43.0	34.3	33.3	31.4	31.5	30.4	29.5	27.3	26.3	25.5	37.5
count > 70	109	60	42	31	25	7	4	3	2	3	1	1	1	1	22

Appendix Table 6: Predicted 24-hour ground level concentrations of PM_{10} for Scenario 2: The Project only without background (µg/m³)

Source	Harbour	Richardson St	BMX	Kingsmill St	Hospital	Taplin St	St Cecilia's	Holiday Inn	Shop	All Seasons	Council	Neptune Pl	Primary School	South Hedland	Wedgefield
Maximum	1.1	0.9	1.0	1.0	0.8	0.8	0.8	0.8	0.9	1.0	1.0	0.7	0.5	3.2	1.9
99th percentile	0.8	0.8	0.7	0.6	0.6	0.5	0.5	0.6	0.5	0.5	0.5	0.4	0.3	2.3	1.4
95th percentile	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	1.6	1.0
90th percentile	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	1.1	0.7
75th percentile	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.4
Average	0.11	0.10	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.05	0.04	0.33	0.25
count > 70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix Table 7: Predicted 24-hour ground level concentrations of PM_{10} for Scenario 3: PHIC and the Project (µg/m³)

Source	Harbour	Richardson St	BMX	Kingsmill St	Hospital	Taplin St	St Cecilia's	Holiday Inn	Shop	All Seasons	Council	Neptune Pl	Primary School	South Hedland	Wedgefield
Maximum	217	212	223	222	217	200	198	195	196	194	194	193	192	187	194
99th percentile	134	138	103	97	92	74	70	66	64	65	64	61	59	62	99
95th percentile	106	89	81	79	73	57	56	52	53	51	49	44	42	47	72
90th percentile	89	79	73	68	63	51	49	47	48	45	44	40	38	39	63
75th percentile	73	62	58	56	52	43	42	40	40	39	37	34	33	30	49
Average	60.6	52.7	48.9	45.7	43.0	34.4	33.3	31.5	31.5	30.5	29.6	27.4	26.3	25.8	37.8
count > 70	109	61	43	31	25	7	4	3	2	3	1	1	1	1	23

Appendix E – $PM_{2.5}$ Model Results

Appendix Table 8: Predicted 24-hour ground level concentrations of PM_{10} for Scenario 1 Base Case, PHIC only, with background (µg/m³)

Source	Harbour	Richardson St	BMX	Kingsmill St	Hospital	Taplin St	St Cecilia's	Holiday Inn	Shop	All Seasons	Council	Neptune Pl	Primary School	South Hedland	Wedgefield
Maximum	43	42	45	44	43	40	40	39	39	39	39	39	38	37	39
99th percentile	27	28	21	19	18	15	14	13	13	13	13	12	12	12	20
95th percentile	21	18	16	16	15	11	11	10	11	10	10	9	8	9	14
90th percentile	18	16	15	14	13	10	10	9	10	9	9	8	8	8	13
75th percentile	15	12	12	11	10	9	8	8	8	8	7	7	7	6	10
Average	12.1	10.5	9.8	9.1	8.6	6.9	6.7	6.3	6.3	6.1	5.9	5.5	5.3	5.1	7.5
count > 25	6	7	3	2	3	1	1	1	1	1	1	1	1	1	2

Appendix Table 9: Predicted 24-hour ground level concentrations of PM_{10} for Scenario 2: The Project only without background (µg/m³)

Source	Harbour	Richardson St	BMX	Kingsmill St	Hospital	Taplin St	St Cecilia's	Holiday Inn	Shop	All Seasons	Council	Neptune Pl	Primary School	South Hedland	Wedgefield
Maximum	0.22	0.19	0.21	0.20	0.16	0.17	0.15	0.17	0.18	0.20	0.20	0.14	0.10	0.64	0.38
99th percentile	0.17	0.16	0.14	0.13	0.12	0.10	0.10	0.11	0.10	0.10	0.10	0.08	0.07	0.45	0.27
95th percentile	0.11	0.10	0.08	0.08	0.08	0.06	0.05	0.05	0.05	0.06	0.06	0.05	0.04	0.31	0.20
90th percentile	0.07	0.06	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.22	0.15
75th percentile	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.08	0.07
Average	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07	0.05
count > 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix Table 10: Predicted 24-hour ground level concentrations of PM_{10} for Scenario 3: PHIC and the Project (µg/m³)

Source	Harbour	Richardson St	BMX	Kingsmill St	Hospital	Taplin St	St Cecilia's	Holiday Inn	Shop	All Seasons	Council	Neptune Pl	Primary School	South Hedland	Wedgefield
Maximum	43	42	45	44	43	40	40	39	39	39	39	39	38	37	39
99th percentile	27	28	21	19	18	15	14	13	13	13	13	12	12	12	20
95th percentile	21	18	16	16	15	11	11	10	11	10	10	9	8	9	14
90th percentile	18	16	15	14	13	10	10	9	10	9	9	8	8	8	13
75th percentile	15	12	12	11	10	9	8	8	8	8	7	7	7	6	10
Average	12.1	10.5	9.8	9.2	8.6	6.9	6.7	6.3	6.3	6.1	5.9	5.5	5.3	5.2	7.6
count > 25	7	7	3	2	3	1	1	1	1	1	1	1	1	1	2

Appendix F – Model input file

```
AERMOD
**
****************************************
**
** AERMOD Input Produced by:
** AERMOD View Ver. 12.0.0
** Lakes Environmental Software Inc.
** Date: 8/08/2024
** File: C:\Projects\1385_GreenSteel\Run1_Receptor\Run1_all.ADI
**
****************************************
**
**
****************************************
** AERMOD Control Pathway
****************************************
**
**
CO STARTING
   TITLEONE Run6a AERMET - Green Steel
   TITLETWO 1385 Run 1, Receptors, 7/8/2024
   MODELOPT CONC DRYDPLT WETDPLT ALPHA
   AVERTIME 1 24 ANNUAL
   POLLUTID PM_10
   RUNORNOT RUN
   LOW_WIND 0.2 0.2828 0.1 0.02 24 0
   ERRORFIL Run1_all.err
CO FINISHED
**
****************************************
** AERMOD Source Pathway
****************************************
**
**
SO STARTING
** Source Location **
** Source ID - Type - X Coord. - Y Coord. **
   LOCATION UNLOAD1      VOLUME     660114  7744782       10.400
   LOCATION UNLOAD2      VOLUME     660113  7744664       11.300
   LOCATION UNLOAD3      VOLUME     660112  7744543        9.640
   LOCATION UNLOAD4      VOLUME     660112  7744423       11.720
   LOCATION TS1          VOLUME     660092  7744642       11.050
   LOCATION TS2          VOLUME     660093  7744767       10.000
   LOCATION TS4          VOLUME     660087  7744403       12.770
   LOCATION TS5          VOLUME     660086  7744525        9.430
   LOCATION TS3          VOLUME     660089  7744892        9.070
   LOCATION TS6          VOLUME     659982  7744892        9.030
   LOCATION TS7          VOLUME     659936  7744891       10.100
   LOCATION TS8          VOLUME     659685  7744737       11.950
   LOCATION TS10         VOLUME     659818  7744449       10.130
   LOCATION TS11         VOLUME     659817  7744363       11.510
   LOCATION TS13         VOLUME     659787  7744362       11.060
   LOCATION TS14         VOLUME     660071  7744332        9.890
   LOCATION TS15         VOLUME     659738  7744327       13.330
```

```
   LOCATION TS9          VOLUME     659670  7744442        11.930
   LOCATION TS12         VOLUME     659856  7744363        11.910
   LOCATION LOAD1        VOLUME     659983  7744364        10.740
   LOCATION LOAD2        VOLUME     660015  7744953         9.050
   LOCATION STACKER1     VOLUME     660073  7744590        10.000
   LOCATION RECLAIMER1   VOLUME     660034  7744569        12.340
   LOCATION STACKER2     VOLUME     659982  7744764        10.520
   LOCATION RECLAIMER2   VOLUME     659957  7744733        11.570
   LOCATION STACKER3     VOLUME     659854  7744724        12.000
   LOCATION RECLAIMER3   VOLUME     659891  7744699        12.230
   LOCATION HBI_YARD     VOLUME     660040  7744578        12.400
** Source Parameters **
   SRCPARAM UNLOAD1            1.0      2.000      3.000      0.930
   SRCPARAM UNLOAD2            1.0      2.000      3.000      0.930
   SRCPARAM UNLOAD3            1.0      2.000      2.000      0.930
   SRCPARAM UNLOAD4            1.0      2.000     12.000      0.930
   SRCPARAM TS1                1.0      3.000     12.000      1.400
   SRCPARAM TS2                1.0      3.000      2.000      1.400
   SRCPARAM TS4                1.0      3.000     70.000      1.400
   SRCPARAM TS5                1.0      3.000     70.000      1.400
   SRCPARAM TS3                1.0      3.000    138.000      1.400
   SRCPARAM TS6                1.0      3.000    137.000      1.400
   SRCPARAM TS7                1.0      3.000     70.000      1.400
   SRCPARAM TS8                1.0      3.000     70.000      1.400
   SRCPARAM TS10               1.0      3.000      2.000      1.400
   SRCPARAM TS11               1.0      3.000     12.000      1.400
   SRCPARAM TS13               1.0      3.000     12.000      1.400
   SRCPARAM TS14               1.0      3.000      2.000      1.400
   SRCPARAM TS15               1.0      3.000      2.000      1.400
   SRCPARAM TS9                1.0      3.000     35.000      1.400
   SRCPARAM TS12               1.0      3.000     35.000      1.400
   SRCPARAM LOAD1              1.0      4.000     35.000      2.330
   SRCPARAM LOAD2              1.0      4.000     35.000      2.330
   SRCPARAM STACKER1           1.0      8.000     35.000      3.720
   SRCPARAM RECLAIMER1         1.0      8.000      2.000      3.720
   SRCPARAM STACKER2           1.0      8.000     12.000      3.720
   SRCPARAM RECLAIMER2         1.0      8.000     12.000      3.720
   SRCPARAM STACKER3           1.0      8.000     25.000      3.720
   SRCPARAM RECLAIMER3         1.0      8.000     25.000      3.720
   SRCPARAM HBI_YARD           1.0      1.500     35.000      0.698
   PARTDIAM UNLOAD1 1 4 7 9
   PARTDIAM UNLOAD2 1 4 7 9
   PARTDIAM UNLOAD3 1 4 7 9
   PARTDIAM UNLOAD4 1 4 7 9
   PARTDIAM TS1 1 4 7 9
   PARTDIAM TS2 1 4 7 9
   PARTDIAM TS4 1 4 7 9
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   PARTDIAM TS3 1 4 7 9
   PARTDIAM TS6 1 4 7 9
   PARTDIAM TS7 1 4 7 9
   PARTDIAM TS8 1 4 7 9
   PARTDIAM TS10 1 4 7 9
   PARTDIAM TS11 1 4 7 9
   PARTDIAM TS13 1 4 7 9
   PARTDIAM TS14 1 4 7 9
   PARTDIAM TS15 1 4 7 9
```

```
PARTDIAM TS9 1 4 7 9
PARTDIAM TS12 1 4 7 9
PARTDIAM LOAD1 1 4 7 9
PARTDIAM LOAD2 1 4 7 9
PARTDIAM STACKER1 1 4 7 9
PARTDIAM RECLAIMER1 1 4 7 9
PARTDIAM STACKER2 1 4 7 9
PARTDIAM RECLAIMER2 1 4 7 9
PARTDIAM STACKER3 1 4 7 9
PARTDIAM RECLAIMER3 1 4 7 9
PARTDIAM HBI_YARD 1 4 7 9
MASSFRAX UNLOAD1 0.31 0.26 0.23 0.2
MASSFRAX UNLOAD2 0.31 0.26 0.23 0.2
MASSFRAX UNLOAD3 0.31 0.26 0.23 0.2
MASSFRAX UNLOAD4 0.31 0.26 0.23 0.2
MASSFRAX TS1 0.31 0.26 0.23 0.2
MASSFRAX TS2 0.31 0.26 0.23 0.2
MASSFRAX TS4 0.31 0.26 0.23 0.2
MASSFRAX TS5 0.31 0.26 0.23 0.2
MASSFRAX TS3 0.31 0.26 0.23 0.2
MASSFRAX TS6 0.31 0.26 0.23 0.2
MASSFRAX TS7 0.31 0.26 0.23 0.2
MASSFRAX TS8 0.31 0.26 0.23 0.2
MASSFRAX TS10 0.31 0.26 0.23 0.2
MASSFRAX TS11 0.31 0.26 0.23 0.2
MASSFRAX TS13 0.31 0.26 0.23 0.2
MASSFRAX TS14 0.31 0.26 0.23 0.2
MASSFRAX TS15 0.31 0.26 0.23 0.2
MASSFRAX TS9 0.31 0.26 0.23 0.2
MASSFRAX TS12 0.31 0.26 0.23 0.2
MASSFRAX LOAD1 0.31 0.26 0.23 0.2
MASSFRAX LOAD2 0.31 0.26 0.23 0.2
MASSFRAX STACKER1 0.31 0.26 0.23 0.2
MASSFRAX RECLAIMER1 0.31 0.26 0.23 0.2
MASSFRAX STACKER2 0.31 0.26 0.23 0.2
MASSFRAX RECLAIMER2 0.31 0.26 0.23 0.2
MASSFRAX STACKER3 0.31 0.26 0.23 0.2
MASSFRAX RECLAIMER3 0.31 0.26 0.23 0.2
MASSFRAX HBI_YARD 0.31 0.26 0.23 0.2
PARTDENS UNLOAD1 1 1 1 1
PARTDENS UNLOAD2 1 1 1 1
PARTDENS UNLOAD3 1 1 1 1
PARTDENS UNLOAD4 1 1 1 1
PARTDENS TS1 1 1 1 1
PARTDENS TS2 1 1 1 1
PARTDENS TS4 1 1 1 1
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PARTDENS TS8 1 1 1 1
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PARTDENS TS11 1 1 1 1
PARTDENS TS13 1 1 1 1
PARTDENS TS14 1 1 1 1
PARTDENS TS15 1 1 1 1
PARTDENS TS9 1 1 1 1
```

```
   PARTDENS TS12 1 1 1 1
   PARTDENS LOAD1 1 1 1 1
   PARTDENS LOAD2 1 1 1 1
   PARTDENS STACKER1 1 1 1 1
   PARTDENS RECLAIMER1 1 1 1 1
   PARTDENS STACKER2 1 1 1 1
   PARTDENS RECLAIMER2 1 1 1 1
   PARTDENS STACKER3 1 1 1 1
   PARTDENS RECLAIMER3 1 1 1 1
   PARTDENS HBI_YARD 1 1 1 1
   HOUREMIS HourlyEmissions_pm10_VerA.txt UNLOAD1 UNLOAD2 UNLOAD3
   HOUREMIS HourlyEmissions_pm10_VerA.txt UNLOAD4 TS1 TS2
   HOUREMIS HourlyEmissions_pm10_VerA.txt TS4 TS5 TS3
   HOUREMIS HourlyEmissions_pm10_VerA.txt TS6 TS7 TS8
   HOUREMIS HourlyEmissions_pm10_VerA.txt TS10 TS11 TS13
   HOUREMIS HourlyEmissions_pm10_VerA.txt TS14 TS15 TS9
   HOUREMIS HourlyEmissions_pm10_VerA.txt TS12 LOAD1 LOAD2
   HOUREMIS HourlyEmissions_pm10_VerA.txt STACKER1 RECLAIMER1 STACKER2
   HOUREMIS  HourlyEmissions_pm10_VerA.txt  RECLAIMER2  STACKER3  RECLAIMER3
HBI_YARD
   SRCGROUP ALL
SO FINISHED
**
****************************************
** AERMOD Receptor Pathway
****************************************
**
**
RE STARTING
   INCLUDED Run1_all.rou
RE FINISHED
**
****************************************
** AERMOD Meteorology Pathway
****************************************
**
**
ME STARTING
   SURFFILE 6866_Run6a_6Feb2015.SFC
   PROFFILE 6866_Run6a_6Feb2015.PFL
   SURFDATA 0 2013
   UAIRDATA 54321 2013
   SITEDATA 1 2013
   PROFBASE 9.0 METERS
ME FINISHED
**
****************************************
** AERMOD Output Pathway
****************************************
**
**
OU STARTING
   RECTABLE ALLAVE 1ST
   RECTABLE 1 1ST
   RECTABLE 24 1ST
   POSTFILE 1 ALL PLOT Run1_all.AD\01_GALL.POS 31
   POSTFILE 24 ALL PLOT Run1_all.AD\24_GALL.POS 32
```

```
   POSTFILE ANNUAL ALL PLOT Run1_all.AD\AN_GALL.POS 33
** Auto-Generated Plotfiles
   PLOTFILE 1 ALL 1ST Run1_all.AD\01H1GALL.PLT 34
   PLOTFILE 24 ALL 1ST Run1_all.AD\24H1GALL.PLT 35
   PLOTFILE ANNUAL ALL Run1_all.AD\AN00GALL.PLT 36
   SUMMFILE Run1_all.sum
OU FINISHED
**
****************************************
** Project Parameters
****************************************
** PROJCTN  CoordinateSystemUTM
** DESCPTN  UTM: Universal Transverse Mercator
** DATUM    World Geodetic System 1984
** DTMRGN   Global Definition
** UNITS    m
** ZONE     -50
** ZONEINX  0
**
```