bhpbilliton
resourcing the future

Section 8
Discharge and Emissions

8 Emissions, Discharges and Wastes

8.1 Overview

Emissions, discharges and wastes will be generated during the dredging, construction, commissioning, operation and decommissioning phases of the proposed Outer Harbour Development Port Hedland.

Emissions, discharges and wastes comprise the authorised or unauthorised release or deposition of material into the environment. These emissions, discharges and wastes may be in the form of gaseous and particulate releases, liquid discharges or solids. There will also be emissions of light and noise.

The potential sources and type of emissions, discharges and wastes that may be produced has been identified together with information on their potential toxicity. This has enabled the potential environmental impacts to be determined (**Sections 9** to **11**). It has also enabled the identification of opportunities for reducing waste volumes and this will form the basis of management plans detailed in **Section 12**.

This section discusses the following emissions, discharges and wastes that may be generated by the Project:

- greenhouse gases;
- atmospheric emissions;
- light;
- noise;
- marine discharges;
- solid wastes; and
- accidental releases (spills and leaks).

8.2 Emissions

8.2.1 Greenhouse Gases Emissions

Overview

The Earth's atmosphere contains a range of gases, which absorb radiant energy and reflect a portion of it back to the Earth's surface to produce a warming effect referred to as the Greenhouse Effect. The main gases responsible for this effect are water vapour, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Human activities, such as the combustion of fossil fuels for the generation of electricity, release greenhouse gases, which have the potential to contribute to climate change.

Existing Environment

Atmospheric concentrations of anthropogenic greenhouse gases have increased substantially over the past 200 years. For example; CO_2 has risen by 35%, CH_4 by 148% and N_2O by 18% (Intergovernmental Panel on Climate Change (IPCC) 2007). These increases have raised concerns that the Earth's natural warming effect is being enhanced and will result in global climate change. The predicted impacts of global climate change are significant and wide-ranging, and include:

- change in global temperature, rainfall and wind patterns;
- shifts in climate zones; and
- rise in sea level.

Based on the latest data available from 2007/2008, current BHP Billiton Iron Ore's Port Hedland port operations, with an export capacity of 155 Mpta, emit approximately 1.65 kg CO_2-e per tonne of iron ore exported. With the development of inner harbour projects, emissions are estimated to reduce to 1.35 kg CO_2-e per tonne of ore exported at a total export capacity at 240 Mtpa (SKM 2011).

Greenhouse Gas Emissions Estimate

It is estimated that over the phased nominal eight year construction period of the proposed Outer Harbour Development Project, approximately 742 kilo tonnes (kt) CO_2-e will be generated. The major contributor to greenhouse gas emissions will be fuel consumption. During full operation approximately 518 kt CO_2-e will be generated per annum, equating to the emission of 2.16 kg CO_2-e per tonne of iron ore exported. The vast majority (approximately 70%) of emissions will result from electricity generation with a further 25% of emissions due to fuel consumption. Potential impacts on climate resulting from aspects associated with the Project and proposed management measures are discussed in **Section 11.10**.

BHP Billiton Iron Ore Corporate Position on Greenhouse Emissions

BHP Billiton Iron Ore Environmental Standard GLD.009 (BHP Billiton 2011) describes the mandatory environmental performance requirements for BHP Billiton operations. To continue addressing associated risks of climate change BHP Billiton Iron Ore is focused on improving the management of greenhouse gas emissions. This focus is built into the decision-making processes through:

- Business targets – BHP Billiton Iron Ore's 5-year company-wide public target on greenhouse gas efficiency improvement is set at 6% over the period 2006 (baseline year) to 2012.

- Energy Excellence Programme – BHP Billiton Iron Ore identifies initiatives and implements business processes that integrate energy source substitution opportunities into operational, engineering, contractual and investment business activities.
- Eco-efficiency identification – Each site has implemented the Eco-efficiency Identification and Implementation Procedure. Initiatives for the reduction of greenhouse gas emissions and energy saving are identified via site workshops, logged, prioritised and implemented.
- Site-based greenhouse gas management plans – All sites have developed energy and greenhouse gas management plans, including targets, improvement project evaluation and associated monitoring and reporting. BHP Billiton requires management plans to be in place for operations where emissions are greater than 50,000 tonnes CO_2-e per annum.

Specific measures to achieve greenhouse gas emission targets include:

- during design, improvements in efficiency are incorporated through engineering specifications;
- through the capital submission process, where operations are required to make modifications or undertake maintenance to existing plant;
- through consultation with site specific works groups, where ownership of improvement ideas and initiatives are given; and
- through purchase of more efficient haulage equipment (e.g. locomotives).

BHP Billiton Iron Ore reports on its global greenhouse gas performance in its Annual Sustainability Summary Report, the latest version of which is for the 2010 financial year. The targets reported in the document include achieving "*Aggregate group target of 6% reduction in greenhouse gases per unit production by 30 June 2012*" and "*aggregate group target of 13% reduction in carbon-based energy use per unit of production by 30 June 2012*".

8.2.2 Atmospheric Emissions (Excluding Greenhouse Gas)

Overview

The primary atmospheric emission as a result of the construction and operation of the proposed Outer Harbour Development will be particulate matter. Dust generated by activities associated with the construction and operation phases of the Project has the potential to impact on the amenity and health of the local residents and the project workforce.

Dust is one of the most visible, invasive and potentially irritating impacts. Nuisance dust is a term generally used to describe dust which reduces environmental amenity without necessarily resulting in material environmental harm. Nuisance dust comprises particles with diameters nominally from about 1 µm up to 50 µm (1 µm = 1 millionth of a metre). This generally equates with 'total suspended particulates' (TSP). Particles smaller than 10 µm are termed PM_{10}. Particles smaller than 2.5 µm are termed $PM_{2.5}$.

The size of particles is directly linked to their potential for causing health effects. Health risks posed by inhaled dust particles are influenced by both the penetration and deposition of particles in the various regions of the respiratory tract and the biological responses to these deposited materials (Department of Health 2007). The smaller the particles, the further they can penetrate the respiratory tract. The largest particles are deposited predominantly in the nasal passages and throat. Much smaller particles, nominally less than 2.5 µm ($PM_{2.5}$), reach the deepest portion of the lungs. Exposure to larger particles (greater than 10 µm) is less of a concern, although they can irritate the eyes, nose and throat.

Many epidemiological studies have linked levels of ambient particulate matter with a variety of human health problems, including mortality, increased hospital admissions and changes to the respiratory system. These effects have been observed through both short-term (usually days) and long-term (usually years) exposure.

Existing Environment

The semi-arid landscape of the Pilbara is a naturally dusty environment. Wind-blown dust is a significant contributor to ambient dust levels within the region. This was highlighted by an aggregated emission study conducted in 2000 (SKM 2003b) which found that the Pilbara region emitted around 170,000 t of windblown particulate matter in the 1998/1999 financial year. Other research has also shown that background levels of dust in the Pilbara region exceed the National Environment Protection Measures (NEPM) 24-hour standard for PM_{10} (particulate matter less than 10 µm in aerodynamic diameter) of 50 µg/m^3 (DoE 2004b).

BHP Billiton Iron Ore's dust monitoring program has been ongoing in the vicinity of Port Hedland since the 1970s. Numerous monitoring sites have been established with high volume (HiVol) samplers and Beta Attenuation Monitors (BAMs) that measure TSP, PM_{10} and $PM_{2.5}$. Receptor locations for both noise and dust monitoring are shown in **Figure 8.1**.

Figure 8.1 Receptor Locations for Dust and Noise Monitoring in the Port Hedland Area

The PM_{10} concentrations recorded at the Port Hedland airport monitoring station (BoM reference site) from July 2004 to June 2010 are presented in **Figure 8.2**. This data indicates that high PM_{10} levels occur on a seasonal basis with higher dust levels occurring predominantly during the summer months.

Despite the naturally high background levels of PM_{10} occurring in the Pilbara region, most of the PM_{10} in the Town of Port Hedland is locally generated (DoE 2004b) with the primary sources of dust originating from existing port operations.

Potential Dust Emissions during Construction

Dust emitted during construction will be localised and temporary. The regular watering of unsealed roads, exposed surfaces and active construction areas will reduce and control these emissions. Major roads and access surfaces will be sealed and the restriction of vehicle movements will further reduce dust emissions from construction activities. As a result of the implementation of these management measures, dust emissions from construction activities will have a temporary, localised, low impact on public amenity. Therefore, emissions during construction have not been assessed further.

Potential Dust Emissions during Operations

The primary emission sources predicted to occur from operation of the project are predominantly associated with wind erosion from stockpiles and open areas, and emissions from stackers.

Numerical modelling was conducted and results developed for the proposed Outer Harbour Development in isolation and cumulatively with other operations at the Port. Cumulative impacts are considered in **Section 11**. The impacts of dust emissions from plant operations associated with the project have been assessed using the Victorian EPA's AUSPLUME Gaussian dispersion model (Version 6) (**Appendix B29**). AUSPLUME is one of the primary models for assessing impacts from industrial sites in Australia and is approved by the Western Australian EPA. The model used meteorological data from the 2004/2005 financial year, which is considered representative of a typical meteorological year at Port Hedland. Due to local terrain and micro-meteorological effects, the actual condition at any one location within the study area may differ slightly from the actual conditions experienced, but in general broadly exhibit the same patterns.

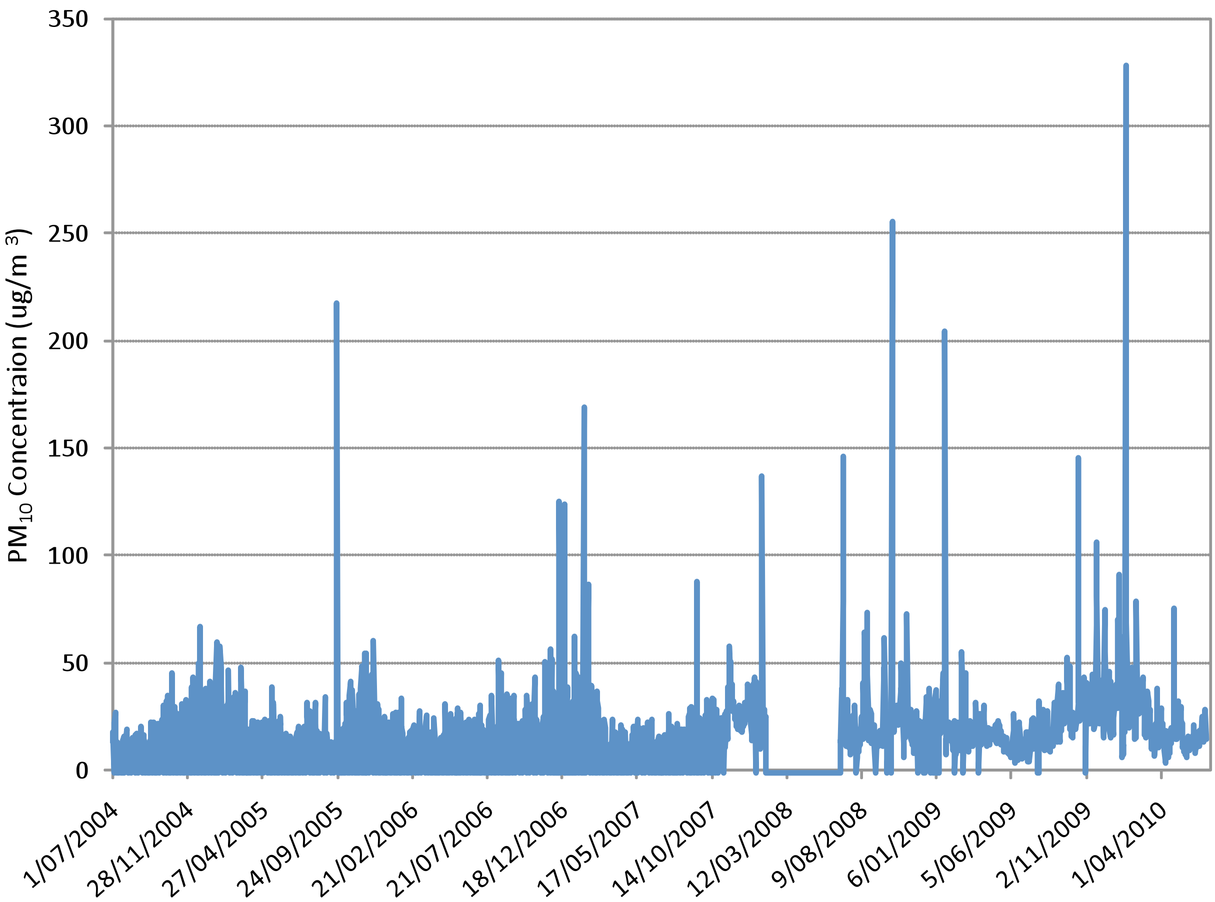

Figure 8.2 – Ambient PM_{10} Concentrations in Port Hedland (BoM – Port Hedland Airport)

BHP Billiton Iron Ore already implements extensive dust controls under the adopted Dust Management Program. Many of these are now included in the design specifications for new equipment installed at Port operations, and will therefore be applied to the Outer Harbour Development. In addition, the following dust reduction measures have been considered and modelled for the project:

- stockyard cannons utilising the algorithms currently used by BHP Billiton Iron Ore operations at Nelson Point and Finucane Island;
- enclosure and dust extraction on all proposed car dumpers;
- enclosure and dust extraction on the new transfer station on Finucane Island;
- belt wash station at the new transfer station on the shiploader wharf to clean the overwater conveyor;
- belt wash station at the new transfer station on Finucane Island to clean the overland conveyor;
- belt wash stations on all new transfer stations;
- use of a predictive meteorological system to predict adverse meteorological conditions to ensure that appropriate dust reductions are undertaken; and
- use of chemical surfactants on the stockpiles and open areas, as directed by the predictive meteorological system, to reduce emissions associated with wind erosion.

In response to the historical land use constraints and projected port development at Port Hedland, the Western Australian Government formed the Port Hedland Noise and Dust Taskforce in May 2009, to develop a coordinated government and industry approach for making recommendations on land use, and dust and noise strategies for the Western End of Port Hedland. The Taskforce considered the Port Hedland Port Authority (PHPA) Ultimate Development Plan, and included the Outer Harbour Development. With the assistance of BHP Billiton Iron Ore, the Taskforce modelled cumulative dust emission profiles for maximum inner and outer harbour capacity (~750 Mtpa) cases. The Taskforce Report which includes improved controls for land use planning and development and revised dust emission target boundaries, has been endorsed by the WA Government. A structured land use planning approach is recommended within these boundaries.

BHP Billiton Iron Ore has been working in collaboration with the relevant agencies and the Taskforce and is committed to actioning the recommendations put forward in the Taskforce's report. BHP Billiton Iron Ore are installing an additional dust monitor, located at Taplin St, as per the Taskforce recommendation, to commence monitoring at this location.

Total Suspended Particulates Emissions

Port Hedland Outer Harbour Development – in Isolation

The potential impact of the project has been modelled as a standalone operation. The predicted ground level TSP concentrations at the 13 sensitive receptor sites (see **Figure 8.1**) as a result of the proposed operations are presented in **Figure 8.3**. The impact of the Outer Harbour Development, as a standalone operation without background concentrations, is represented as a contour plot in **Figure 8.4**.

Wedgefield is predicted to experience a maximum predicted 24 hour average TSP concentration of 19 µg/m^3 and a predicted increase in the annual average concentration of 3.2 µg/m^3 due to its proximity to the proposed operations.

The Hospital receptor is predicted to experience an increase in the annual average TSP concentration of 1.1 µg/m^3 while the maximum 24 hour average concentration is predicted to be 6 µg/m^3. The maximums at receptors within Port Hedland were attributed to high emissions from stackers under adverse meteorological conditions. However, the predicted concentrations at these receptors are low on average, making these maximums isolated events.

The predicted 24 hour TSP statistics at the Hospital monitoring station and the proposed Taplin Street locality as a result of the project, with and without background concentrations, are displayed in **Table 8.1**. For reference, the background concentrations are also presented in this table. From the results presented in this table, it is evident that the Outer Harbour Development, as a stand-alone operation, is predicted to have minimal impact at the Hospital and Taplin Street receptors. The Outer Harbour Development is predicted to have no impact on the maximum concentration and only relatively minor impacts on the remaining statistics, including the annual average.

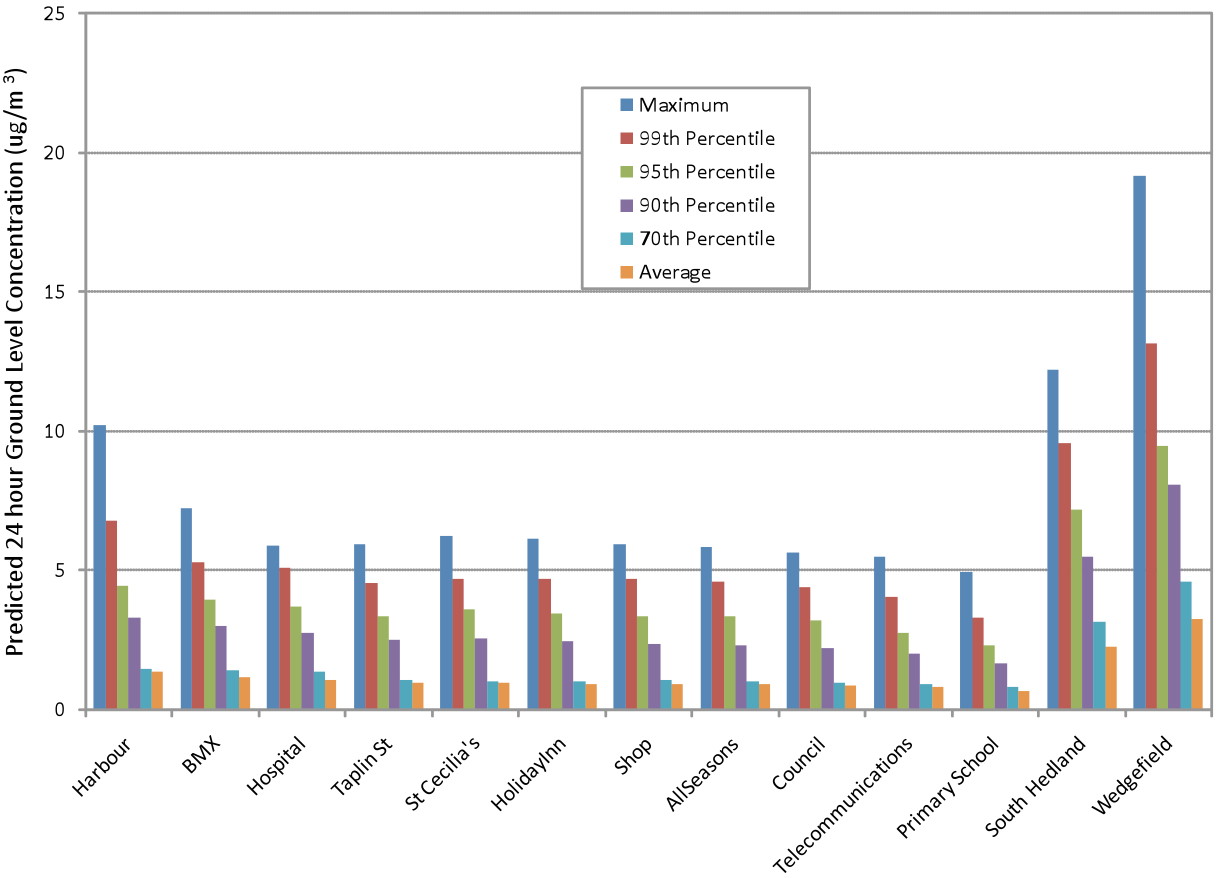

Figure 8.3 – Statistics of Predicted 24 hour TSP Ground Level Concentrations from the Proposed Outer Harbour Development (standalone with no background)

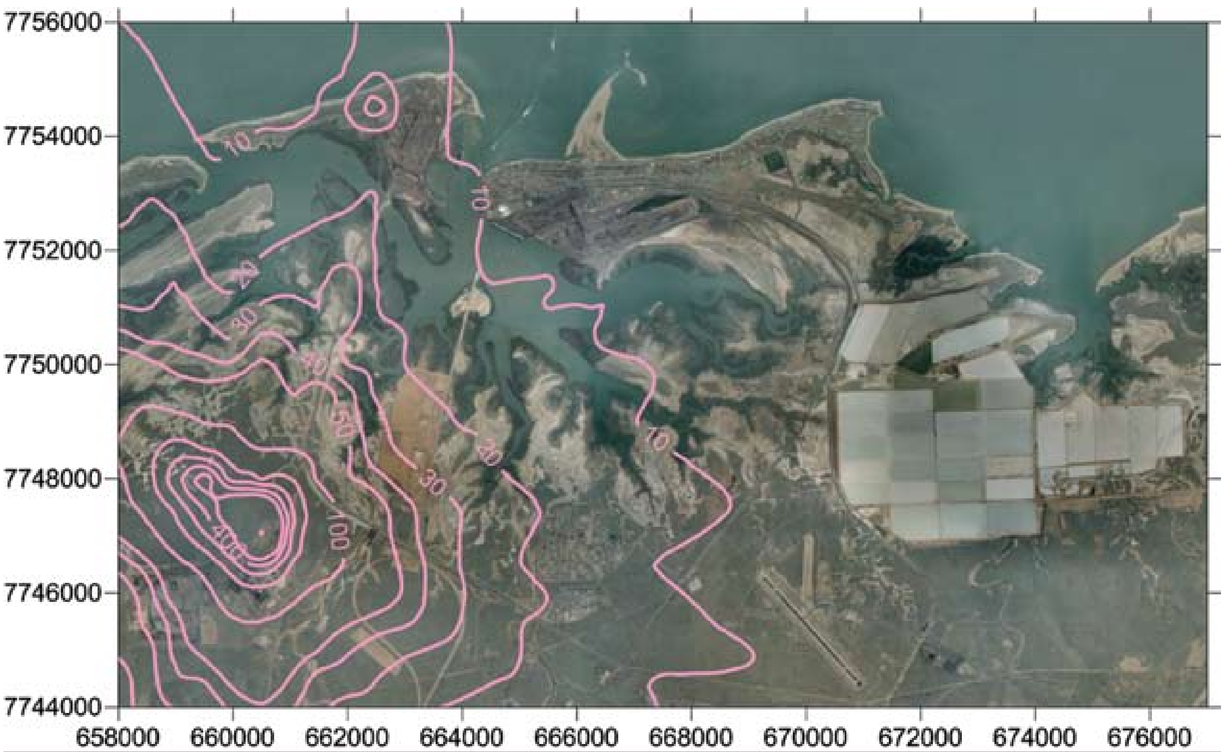

Figure 8.4 – Maximum Predicted 24 hour TSP Ground Level Concentrations from the Proposed Outer Harbour Development (no background)

Table 8.1 – Predicted TSP Ground Level Hospital Concentrations from the proposed Outer Harbour Development (μg/m^3)

Operation	Receptor	Maximum	99th Percentile	95th Percentile	90th Percentile	70th Percentile	Annual Average
Background concentration	NA	151	83	60	50	33	33.3
Outer Harbour Development	Hospital	6	5	3	3	1	1.0
	Taplin St	6	5	4	3	1	0.9
Outer Harbour Development With background data	Hospital	151	84	62	51	36	34.4
	Taplin St	151	84	61	51	36	34.3

PM_{10} Emissions

Port Hedland Outer Harbour Development – in Isolation

The ground level PM_{10} concentrations predicted to occur at the 13 sensitive receptor sites (see **Figure 8.1**) as a result of the proposed operations are presented in **Figure 8.5**. The impact of the Outer Harbour Development, as a standalone operation without background concentrations, is represented as a contour plot in **Figure 8.6**.

Wedgefield is predicted to experience a maximum 24 hour average PM_{10} concentration of 13 μg/m^3 and an increase in the annual average concentration of 2.2 μg/m^3 due to its proximity to the proposed operations.

The Hospital receptor is predicted to experience an increase in the annual average concentration of 0.8 μg/m^3 while the maximum 24 hour average PM_{10} concentration is predicted to be 5 μg/m^3.

The maximums at receptors within Port Hedland were attributed to high emissions from stackers under adverse meteorological conditions. However, the concentrations at these receptors are low on average, making these maximums isolated events.

The predicted 24-hour PM_{10} statistics at the Hospital monitoring station and the proposed Taplin Street locality as a result of the project, with and without background concentrations, are displayed in **Table 8.2**. The results indicate that the Outer Harbour Development (as a standalone operation) is predicted to have minimal impact at the Hospital and Taplin Street receptors.

The Outer Harbour Development is predicted to have no impact on maximum or the 99th percentile predicted concentration and only relatively minor impacts on the remaining statistics, including the annual average.

Table 8.2 – Predicted PM_{10} Ground Level Hospital Concentrations from the proposed Outer Harbour Development (μg/m^3)

Operation	Receptor	Maximum	99th Percentile	95th Percentile	90th Percentile	70th Percentile	Annual Average	Annual Average
Background concentration	NA	71	57	39	32	22	20	1
Outer Harbour Development	Hospital	5	4	3	2	1	0.8	0
	Taplin St	5	3	3	2	1	0.7	0
Outer Harbour Development With background data	Hospital	71	57	40	33	23	21.0	1
	Taplin St	71	57	40	33	23	20.9	1

Note: The single annual exceedance that occurs in all scenarios is a function of a 'natural' background exceedance.

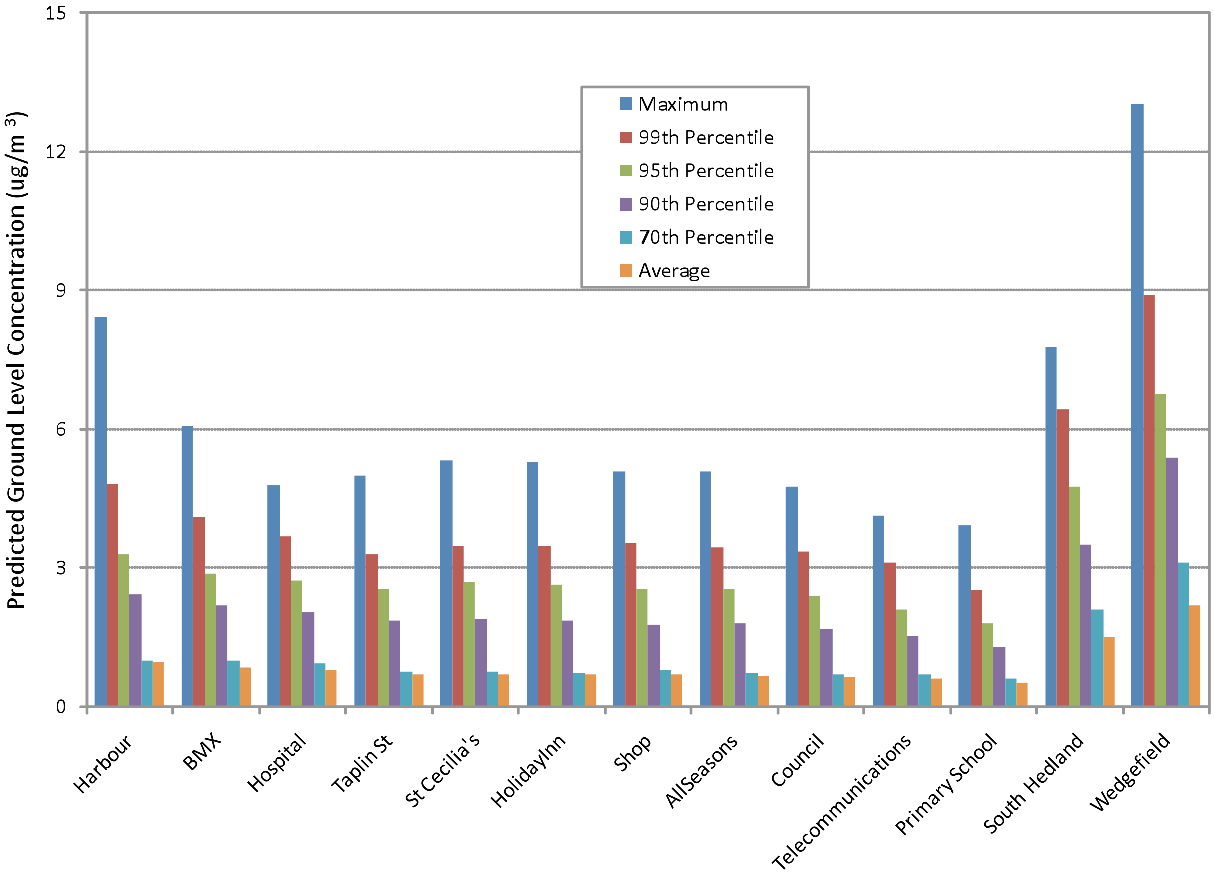

Figure 8.5 – Statistics of Predicted 24-hour PM_{10} Ground Level Concentrations from the Proposed Outer Harbour Development (standalone with no background)

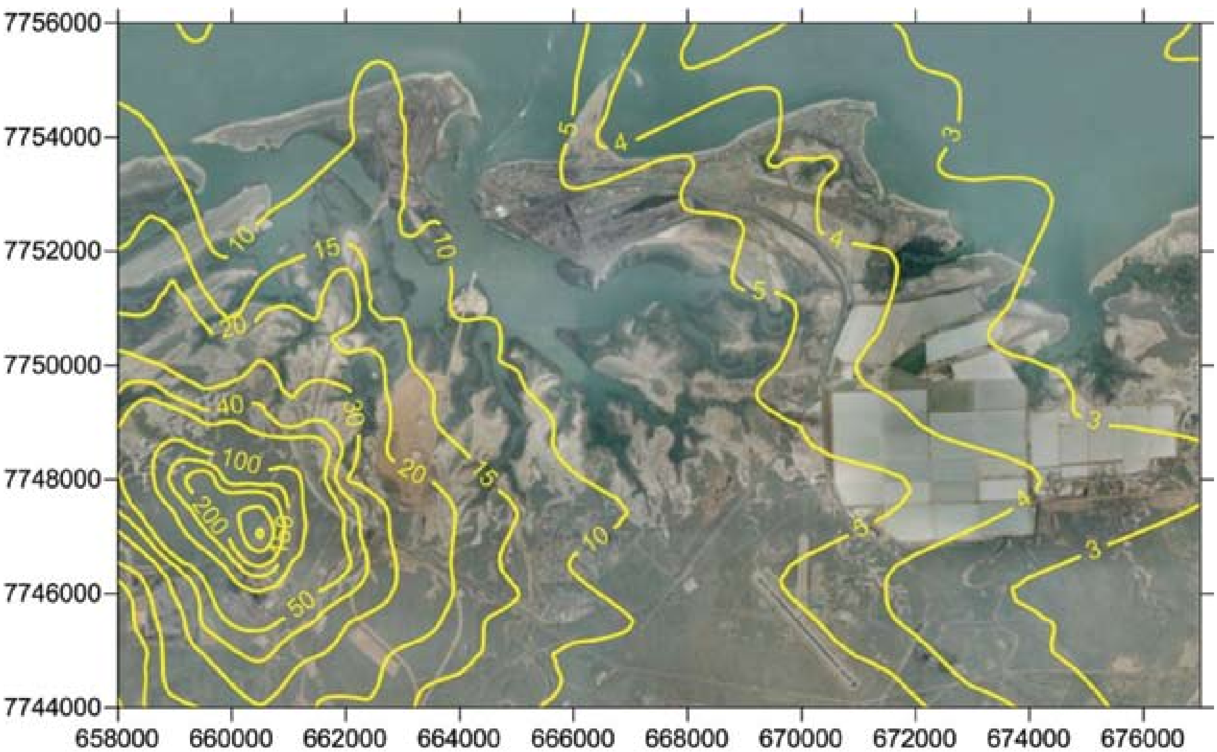

Figure 8.6 – Maximum Predicted 24-hour PM_{10} Ground Level Concentrations from the Proposed Outer Harbour Development (no background)

Impact Assessment

Potential impacts on terrestrial environmental and social receptors due to terrestrial dust emissions associated with the Outer Harbour Development and proposed management measures are discussed in the following sections:

- **Section 9.2.4** – Terrestrial Fauna
- **Section 11.4** – Public Amenity
- **Section 11.6** – Public Health

8.2.3 Light

Overview

The generation of artificial light from construction and operation of the Outer Harbour Development has the potential to result in light spill, particularly during night-time operations. The amount of light spill generated from the onshore and offshore facilities during construction and operation will be determined by the wavelength and intensity of the light source, the location and/or placement of light fittings and the method of light switching. Light intensity, similar to noise, attenuates with distance.

Existing Environment

There are a number of existing light sources within the Port Hedland vicinity including existing Port Hedland Port facilities at Nelson Point, Anderson Point, Utah Point and Finucane Island. Other local sources include lighting from the towns of Port Hedland and South Hedland and communities at Wedgefield.

A light spill study undertaken in 2009 (Bassett 2009) assessed the existing night-time views of lights from receptor locations of varying viewing significance (as defined by WAPC 2007). Port Hedland Town, South Hedland and Wedgefield are primarily influenced by existing street lighting and sports field lighting to varying degrees (Bassett 2009). Light spill from the decommissioned HBI Plant and Fortescue Metals Group (FMG) port infrastructure is visible from Wedgefield and South Hedland but is located at a sufficient distance from these areas (more than 2 km) that it is unlikely to be intrusive for residents. Light spill from the existing port infrastructure on Finucane Island is visually dominant from the western section of Port Hedland.

Existing illuminance was measured at a number of locations near the Outer Harbour Development including the Gazebo at Point Laurentius (West Port Hedland), Port Hedland Hospital, Port Hedland All Seasons Hotel (Port Hedland East), South Hedland and Wedgefield. In general, illuminance values recorded at all sites are below the values recommended in the Australian Standard (AS 4282:1997 Control of the Obtrusive Effects of Outdoor Lighting), which recommends levels of light that may be considered acceptable for various surrounding land uses (Bassett 2009).

Cemetery Beach, Cooke Point and Pretty Pool are three locations confirmed as turtle nesting areas in the vicinity of the Outer Harbour Development. As a result, an assessment of light emissions from existing sources was undertaken for the proposed Outer Harbour Development (Bassett 2009) (**Appendix B5**).

As part of the light assessment, existing artificial light sources at turtle nesting beaches were inspected and lighting was measured in terms of the quantity of light (illuminance) and its intensity (luminance) (Bassett 2009). Monitoring locations are shown in **Figure 6.16**. The study found that some existing lighting, including street lighting, sports and feature lighting (the water tower at Cemetery Beach and Matheson Oval lighting at Cooke Point and Pretty Pool) is visible at all three turtle nesting beaches, but the quantity and intensity of these artificial light sources is less than that produced during a full moon. As such, these lighting sources do not present a significant local source of light pollution (Bassett 2009).

Light Emission Estimates

Construction lighting typically consists of bright white (metal halide, halogen, florescent) lights or point sources. These lights will be used offshore during the construction phase on a 24-hour basis. Vessels operating offshore from Port Hedland during dredging of the navigation channel, associated spoil disposal and construction of the jetty and wharf will require 24-hour lighting. The dredging associated with construction of the navigation channel, turning basins and berthing pocket is anticipated to take up to 56 months (refer to **Section 2.5.3**). Temporary lighting will also be provided during construction of the onshore facilities, including the corridor across West Creek.

The light sources associated with major components of the Outer Harbour Development infrastructure during operations and considered in the light impact assessment are summarised below:

Offshore infrastructure:

- jetty – high pressure sodium;
- wharf – high pressure sodium;
- berths with berthed ships – high pressure sodium; and
- ship loaders – high pressure sodium.

Terrestrial infrastructure:

- transfer station on Finucane Island – high pressure sodium;
- infrastructure corridor/overland conveyor – high pressure sodium; and
- stockyards at Boodarie – high pressure sodium and metal halide.

Sensitive receptors include residential areas at Port Hedland (the Hospital), Wedgefield and South Hedland and environmental receptors at turtle nesting beaches including Cemetery Beach, Cooke Point and Pretty Pool Beach. Outcomes of the light assessment (Bassett 2009) for the Outer Harbour Development in isolation are presented below.

Direct Light

Modelling of the Outer Harbour Development in isolation revealed that there will be no direct light spill at Cook Point or Pretty Pool. Light spill at Cemetery Beach is predicted to occur to a maximum illuminance of 0.001 lux (three orders of magnitude less than bright moonlight (0.2 lux)). This impact is considered insignificant (Bassett 2009).

Modelling of the project in isolation revealed that there will be no direct light spill at South Hedland. Receptors in Port Hedland are predicted to experience direct illumination of up to 0.01 lux. This illuminance is the same order of magnitude as that modelled for the existing port developments, which suggests that there will be no noticeable change in port development lighting received at these locations (Bassett 2009).

The direct light spill at Wedgefield is predicted to be in the order of 0.009 lux. This light spill is lower than that likely to have resulted from the Boodarie HBI plant infrastructure when it was fully operational (0.001 to 0.014 lux), and remains several orders of magnitude lower than bright moonlight (Bassett 2009).

Ambient Light

The light spill from the Outer Harbour Development will provide a minimal contribution to the ambient lighting present at Cemetery Beach and will represent no noticeable change in light spill as it is at least one order of magnitude less than cumulative ambient lighting (Bassett 2009).

The light spill from the project will also provide a minimal contribution, if any, to the cumulative ambient lighting present at all residential areas other than Wedgefield and will not represent a noticeable change in light spill as it is at least one order of magnitude less than ambient lighting. Light spill from the project at Wedgefield (0.009 lux) may contribute a measurable change to the existing ambient light spill as measured at 0.04 lux (Bassett 2009).

Predicted values of illumination at all residential locations are less than that stipulated under Australian Standard AS4282:1997 Control of the Obtrusive Effects of Outdoor Lighting.

Impact Assessment

Potential impacts on environmental and social factors resulting from light spill associated with the Outer Harbour Development and proposed management measures are discussed in the following sections:

- **Section 9.2.4:** Terrestrial Fauna
- **Section 10.4:** Marine Fauna
- **Section 10.6:** Avifauna
- **Section 11.5:** Visual Amenity.

8.2.4 Noise

Overview

Terrestrial and marine noise emissions will be generated during the construction and operation phases of the Outer Harbour Development. Predicted noise emissions are presented in this section. Potential impacts and management associated with these noise emissions are discussed in **Sections 10** and **11**.

Terrestrial Noise

Existing Environment

The close proximity of port operations to residential areas in Port Hedland has historically given rise to community concerns regarding noise impacts, particularly for those living near to the port facilities. The noise emissions are not continuous in nature and their characteristics can vary considerably depending on the activities being undertaken. There can be overlap of noise emitted from a number of port users and from other activities in the Port Hedland area, and as a consequence noise emissions can be cumulative at their point of impact. Traffic noise associated with major arterial roads makes a considerable contribution to local noise levels during the day and into the evening.

Prevailing weather conditions also have a significant influence on the extent to which noise emitted by port operations may impact on the community, particularly at night when atmospheric conditions can enable noise to travel greater distances.

Ambient noise levels vary temporally and spatially. The *Environmental Protection (Noise) Regulations 1997* specify noise levels (assigned and maximum) which are the highest noise levels that can be received at noise sensitive premises, commercial premises and industrial premises, dependent upon the time of day.

Noise surveys of BHP Billiton Iron Ore's Port Hedland operations have been undertaken progressively over the years – commencing prior to the PACE Project (2004). Environmental noise emissions from BHP Billiton Iron Ore's Port Hedland facilities do not currently comply with the assigned noise emission levels of the *Environmental Protection (Noise) Regulations 1997*.

Monitoring programs undertaken in Port Hedland over the past six years indicate that assigned noise levels are being exceeded. The Hospital monitoring site has traditionally been selected as the benchmark for the noise sensitive receivers. The approximate margin of exceedence of LA_{10} noise levels observed at the Hospital monitoring site as a result of BHP Billiton Iron Ore's operations is (SVT 2011):

- night (2200–0700): up to 23 dB(A);
- evening (1900–2200): up to 18 dB(A); and
- day (0700–1900): up to 13 dB(A).

An intensive 11-site noise monitoring program was undertaken over two periods from 22 February to 5 March 2008 and from 6 to 20 March 2008. The noise levels recorded at the Hospital site over a two week interval in February 2008 are presented in **Figure 8.7**. These data indicate a typical diurnal cycle with higher levels experienced during daytime hours.

In this context, BHP Billiton Iron Ore has developed an Environmental Noise Reduction Management Plan (BHP Billiton Iron Ore 2009b) to improve the control of noise from BHP Billiton Iron Ore's operations at Port Hedland and to facilitate the management of noise emissions from the Nelson Point and Finucane Island operations.

In recent expansion projects BHP Billiton Iron Ore has adopted the approach of ensuring that newly installed plant and infrastructure complies with the *Environmental Protection (Noise) Regulations 1997* (where practicable) and that the cumulative noise emission from each project should not result in a net increase in noise levels at the Hospital site. Where land use constraints result in this being impracticable, final noise emission levels will be considered in a Section 17 Noise Regulation exemption process (BHP Billiton Iron Ore 2009b).

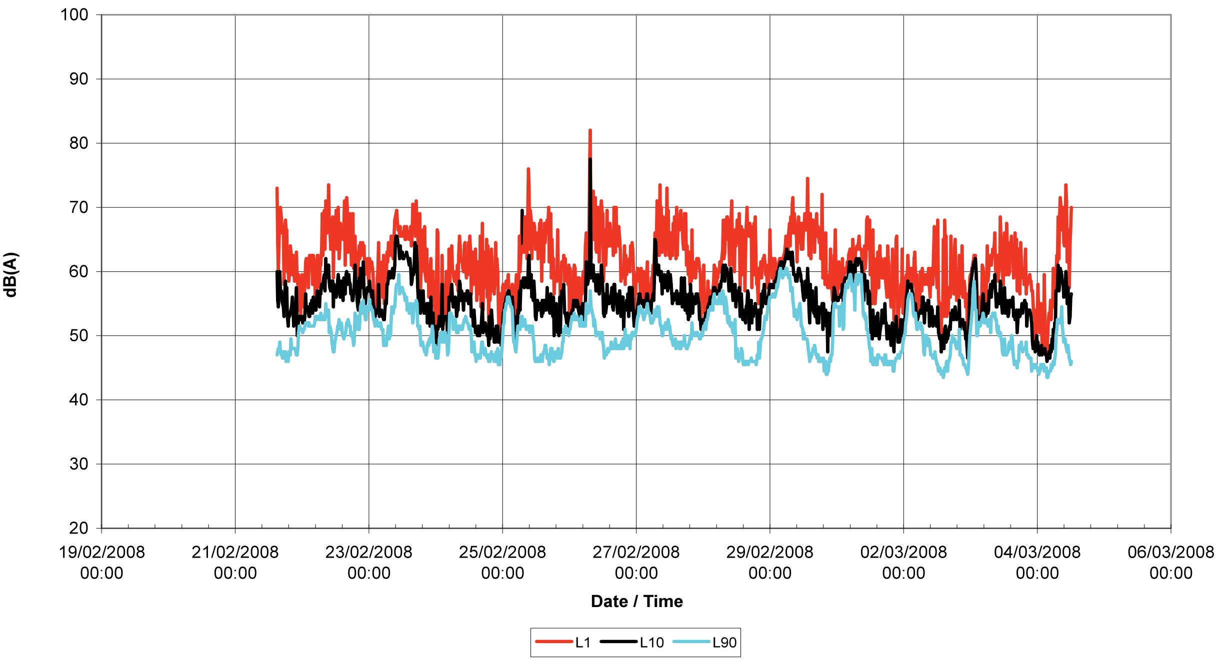

Figure 8.7 – Ambient Noise Levels Recorded at the Hospital Site, Port Hedland 22 February to 5 March 2008

Source: SVT (2011)

Noise Criteria

Noise from Fixed Plant

The Environmental Protection (Noise) Regulations 1997 apply to all construction activities. Where construction activities are undertaken during daylight hours (7 am to 7 pm, Monday to Saturday (excluding public holidays)) the assigned and maximum permissible noise levels can be exceeded provided that prescribed best practice noise control techniques are employed. This includes:

- construction work carried out in accordance with control of noise practices set out in Section 6 of Australian Standard AS 2346:1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites, and
- regular monitoring and maintenance of equipment so that it remains in good working condition and noise emissions kept to a minimum.

Where construction activities are undertaken outside daylight hours (7 am to 7 pm) or on Sundays and public holidays, the assigned and maximum permissible noise levels can be exceeded provided that a set of prescribed additional conditions are satisfied. These include:

- demonstration that it was reasonably necessary for the construction work to be carried out; and
- prior notification of construction works to occupiers of premises where assigned and maximum noise levels are likely to be exceeded.

Comparison is made with the assigned noise levels specified in the *Environmental Protection (Noise) Regulations 1997* and measured ambient noise levels (**Table 8.3**).

Rail Noise

Rail noise is specifically excluded from the *Environmental Protection (Noise) Regulations 1997*. A State Planning Policy which addresses road and rail noise impacts in the context of land use planning has been published by the Western Australian Planning Commission (WAPC 2009). The Policy prescribes outdoor noise criteria for noise sensitive land uses next to new roads or railways (**Table 8.4**).

Table 8.4 – Outdoor Noise Criteria for Noise Sensitive Land Uses Next to New Roads or Railways*

Time Period	Noise Target	Noise Limit
Day: 0600-2200 hours	LAeq = 55 dB(A)	LAeq = 60 dB(A)
Night: 2200-0600 hours	LAeq = 50 dB(A)	LAeq = 55 dB(A)

**When predicting transport noise levels under this policy it is a general rule that a +2.5 dB facade correction is applied to both road and rail.*

Source : WAPC 2009.

Potential Noise Emissions during Construction

A range of construction activities, including pile driving during the wharf construction (over a 24 month period) and heavy earthmoving machinery, will generate noise.

Pile Driving Activities

The impact of noise emissions from piling activities during construction of the Outer Harbour Development was assessed by SVT (2011), and is included as **Appendix B8**. The acoustic model was developed using SoundPlan modelling software. In accordance with EPA's recommendations outlined in the Draft Guidance Statement No.8: Environmental Noise (EPA 2007) the modelling assumed worst case meteorological conditions as a conservative assessment case. Additional scenarios for onshore,

Table 8.3 – Summary of Assigned and Maximum Permissible Noise Levels at Port Hedland (L_{A10} dB (A)) Relative to Measured Background Levels

Receptor	Influencing Factor	L_{A10} Assigned Noise Levels			Penalty	L_{A10} Maximum Allowable Noise Levels			Measured LA_{10} Background Noise Levels (24 hour range)
		Day	Evening	Night		Day	Evening	Night	
Brearley Street*	2	47	42	37	5	42	37	32	45-57
Hospital	2	47	42	37	5	42	37	32	51-58
Police Station	17	62	57	52	5	57	52	47	47-55
Pretty Pool	0	45	40	35	0	45	40	35	42-57
South Hedland	0	45	40	35	0	45	40	35	49-55
Wedgefield	9	54	49	44	0	54	49	44	41-51

Nearest monitoring location 149 Anderson Street, Port Hedland* offshore and calm wind conditions were modelled. The approximate temporal distribution of these weather categories observed in Port Hedland is presented in **Table 8.5. The sound power levels for the piling activities were based on measured data for similar equipment and used to predict levels at noise sensitive locations (receptors) for the area around Port Hedland, South Hedland and Wedgefield.

For the proposed piling activities, the following configuration was modelled:

- pile driving undertaken from 7 am to 7 pm Monday to Sunday (excluding public holidays);
- pile driving extending from 7 pm to 10 pm Monday to Sunday (excluding public holidays), modelled as a sensitivity case;
- five pile barges operating simultaneously in the construction of the jetty/wharf structures at representative locations closest to the noise sensitive receptors;
- pile diameter 1,300 mm and length 30 m; and
- piles driven by impact hammer.

Table 8.5 – Approximate Temporal Distribution of Modelled Meteorological Scenarios

Scenario	Port Hedland Wind Conditions	Percentage Time/Annually
1	Worst case meteorological conditions[1]	1.9
2	Onshore wind up to 3 m/s	0.5
3	Offshore wind up to 3 m/s	0.9
4	Calm at 0 m/s[2]	0.6

[1] Worst case meteorological conditions as defined in Draft Guidance Statement No. 8: Environmental Noise (EPA 2007). Pasquill stability categories E and F.

[2] Pasquill stability category D has been used to approximate for calm conditions.

Source of meteorological data: Bureau of Meteorology (BoM) 2009a.

Observations from the monitoring program indicate that ambient noise levels in Port Hedland exceed the assigned noise levels (refer **Table 8.3**). A summary of the predicted noise levels at the receptors due to pile driving for the project is given in **Table 8.6**. Although the differing characteristics of piling and ambient noise limit the extent to which direct comparisons can be made, it is predicted that the piling noise is unlikely to exceed daytime ambient noise levels at the Hospital site.

Potential Noise Emissions during Operation

Noise emissions from the operation of the Outer Harbour Development can be considered as consisting of two significant components: noise from fixed plant and noise from rail transport. Noise generated by light vehicle movements including water trucks, utilities and road sweepers is considered to be negligible and has not been modelled.

Noise from Fixed Plant

The major fixed plant noise sources for the Outer Harbour Development operations include:

- car dumpers;
- screen house;
- stackers and reclaimers;
- conveyors;
- conveyor drives/transfer stations; and
- shiploaders.

The highest noise emitters are expected to be the conveyor idlers and conveyor drives.

The impact of noise emissions from fixed plant and rail activities during the operation of the proposed Outer Harbour Development was assessed by SVT (2011) (refer to **Appendix B7**), using the SoundPlan modelling software. The predicted noise impacts were assessed for both the proposed Outer Harbour Development in isolation and the cumulative noise effects of the development and existing or proposed Inner Harbour developments (such as Rapid Growth Project 5 (RGP5)). Cumulative noise modelling and results are discussed in **Section 11**.

The noise sources in the model were located so that they would provide the worst case noise impacts for Port Hedland including worst case meteorological conditions. The sound power levels for the sources were based on measured data for similar equipment at BHP Billiton Iron Ore's existing port operations. The model has been used to predict noise levels at selected noise receptors for the area around Port Hedland, South Hedland and Wedgefield. The model findings for the Outer Harbour Development in isolation are presented in **Table 8.7**.

Table 8.6 – Noise Levels (L_{A10}dB(A)) Generated by Pile Driving associated with the Outer Harbour Development in Isolation

Receptor	Weather Scenario 1	Weather Scenario 2	Weather Scenario 3	Weather Scenario 4
Brearley Street	48.8	44.0	37.1	39.0
Hospital	54.1	49.3	41.2	43.8
Police Station	52.7	47.9	40.3	42.9
Pretty Pool	40.3	35.6	30.5	31.4

Table 8.7 – Statistics for Noise Levels (LA_{10} dB (A)) generated by the operation of the Proposed Outer Harbour Development In-Isolation without Noise Control

Receptor	Stage 1	Stage 1-2	Stage 1-3	Stage 1-4	Stage 1-5	Night-Time Assigned Noise Levels
Brearley Street	35.7	43.9	46.9	48.7	49.9	37.0
Hospital	43.0	43.0	51.2	52.9	54.2	37.0
Police Station	50.4	50.4	52.3	54.1	55.3	47.0
Pretty Pool	28.9	28.9	39.7	41.5	42.8	35.0
South Hedland	29.2	29.2	34.7	36.4	37.7	35.0
Wedgefield	36.2	36.2	40.0	41.7	43.0	44.0

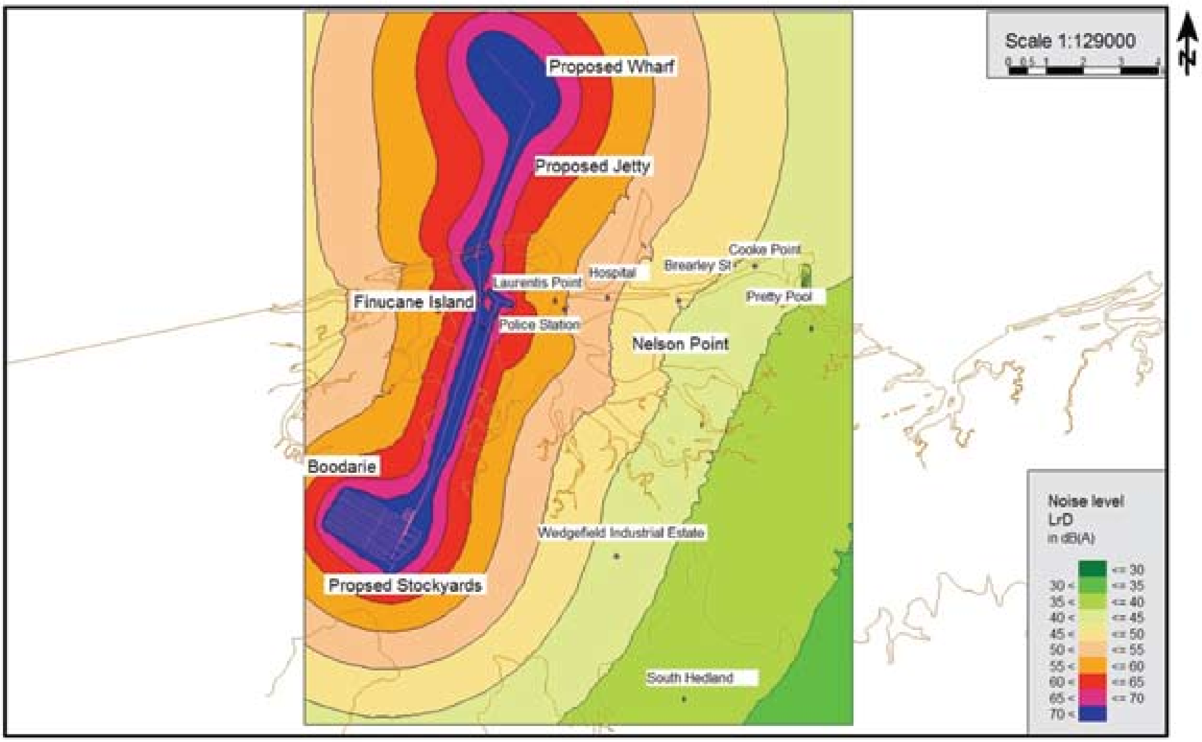

Figure 8.8 – Modelled Noise Levels for the Outer Harbour Development to Stage 5, in Isolation

Table 8.8 – Predicted LAeq Values (dB (A)) for Western Spur Railway in Isolation

Receptor	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Criteria
Brearley Street	19.4	22.4	24.2	25.4	26.4	55
Hospital	21.3	24.3	26.1	27.3	28.3	55
Police Station	22.4	25.4	27.2	28.4	29.4	55
Pretty Pool	17.7	20.7	22.5	23.7	24.7	55
South Hedland W	25.7	28.7	30.5	31.7	32.7	55
South Hedland S	24	27.0	28.8	30.0	31.0	55
Wedgefield construction Camp	26.1	29.1	30.9	32.1	33.1	55
Green Acres	28.1	31.1	32.9	34.1	35.1	55

Rail Noise

The rail noise assessment comprised of the following prospective operational configurations:

- Western Spur Railway and Boodarie Loop;
- current Newman rail line rail operations from Bing Siding to Nelson Point and Finucane Island; and
- rail yard operations at Nelson Point and Finucane Island.

The predicted rail noise levels in isolation at each of the receptors are presented in **Table 8.8** and **Figure 8.8**. The findings indicate that the rail noise will not exceed the targeted criteria contained in State Planning Policy 5.4 (WAPC 2009d).

Impact Assessment

Potential impacts on terrestrial environmental and social receptors due to terrestrial noise emissions associated with the Outer Harbour Development and proposed management measures are discussed in the following sections:

- **Section 9.2.4** – Terrestrial Fauna
- **Section 11.4** – Public Amenity

Marine Noise

Existing Environment

Anthropogenic and natural noise can impede acoustic communication and other functions of marine biota. Relatively little is known about the effects of natural marine noise on marine animals in the oceans (NOAA 2004).

Noise in the marine environment is derived from a number of biological and physical sources. Marine noise sources include:

- naturally occurring biological sounds produced by animals such as whales, dolphins and fish;
- naturally occurring physical sounds such as waves, seismic activity, thunder and lightning; and
- noise associated with human activities such as shipping and construction.

Marine animals in the vicinity of the Outer Harbour Development that may be affected by anthropogenic noise emissions include turtles and mammals. Habitat used for nesting by flatback turtles exists within the marine study area. Small rookeries are present at Cemetery Beach and Pretty Pool (approximately 5 km to the south-east). Although seagrass species suitable for foraging dugongs are known to occur in the Port Hedland region, the extent of these seagrasses is not considered adequate to support permanent populations, and there is no recognised feeding or breeding areas for whales in the immediate vicinity of Port Hedland Harbour (**Section 6.6.5**).

Cetaceans are considered to be particularly sensitive to anthropogenic noise as it can impair their ability to echolocate, locate and capture food, detect predators and sense their biological and physical environment (which in the worst case may lead to disorientation and beaching).

An evaluation of the existing noise sources in the vicinity of the Outer Harbour Development was undertaken by Curtin University (Jenner & Thiele 2008). A CMST-DSTO sea noise logger was deployed on the seabed in 14 m CD depth of water, approximately 560 m east north-east of the PHPA Channel Marker 14 and 38 km north-east of the coast at Port Hedland harbour (**Figure 6.24**) from October 9 to 23, 2008, capturing a full spring-neap tidal cycle. The sea noise logger was set to record five minutes out of every 15 minutes, resulting in over 2,000 recordings. The main sources of noise identified from analysis of sea noise logger recordings included:

- vessels;
- humpback whale signals; and
- fish.

Vessel noise is likely to represent an increasingly large component of marine noise in the Port Hedland region. From 2004 to 2008, annual shipping traffic to Port Hedland Harbour increased from 773 to 1,027 vessels (PHPA 2008b).

Marine noise sources can be highly seasonal, particularly those of a biological origin. The noise monitoring occurred when large pods of humpback whales were likely to be migrating southwards past Port Hedland. At a different time of year, humpback whale signals are unlikely to have been recorded, or at least contributed proportionately less to overall marine noise. Likewise, the physical sea noises recorded may not be an accurate reflection of this source's proportionate input at other times during the year. Increased natural noise levels are expected from wave action, thunder and lightning from storms and cyclonic activity during the summer months.

Potential Noise Emissions

Marine noise will be generated during construction and operation of the Outer Harbour Development from various activities, vessels and fixed structures. Principal marine noise sources include:

- pile drivers;
- dredging including equipment such as the Cutter Suction Dredge (CSD) and Trailing Suction Hopper Dredge (TSHD); and
- increased shipping and vessel traffic associated with harbour works.

It should be noted that noise is propagated and measured differently in water than on land. The standard scientific approach is to describe underwater noise levels in terms of sound pressure. While a decibel (dB) is a relative measure of sound, in order to make this measure meaningful for underwater noise, it is referenced to a standard 'reference intensity' of 1 mPa (dB re 1μPa). Underwater noise is also measured over a specified frequency, usually either a 1 Hz bandwidth (expressed as dB re 1μPa^2/Hz), or over a broadband that has not been filtered. Where the frequency has not been expressed, it is assumed that the measurement is a broadband measurement.

Naturally occurring noise levels in the ocean as a result of wind and wave action may range from around 90 dB re 1μPa under very calm, low wind conditions to 110 dB re 1μPa under windy conditions.

Factors needing consideration to assess the impacts of these noise sources are:

- the impinging underwater noise characteristics (i.e. sound level, noise duration, frequency content);
- the sound propagation characteristics of the area;
- the sensitivity to sound of the species of concern;
- physical robustness, size and age of the species;
- life history and relative population sensitivity; timing of different stages of life history;
- animal distribution and abundance;
- migration patterns; and
- whether the species can or are likely to move away from the noise if distressed by it.

Very little information was available on the distribution, timing of occurrence, life history, and behavioural patterns of fauna for much of the region around Port Hedland. By drawing from the available information it can broadly be said that the following marine mammal species will either occur within the development footprint or within proximity to it, either as residents or migrating animals:

- humpback whales;
- Indo-Pacific humpback dolphins;
- snubfin dolphins;
- bottlenose dolphins; and
- dugongs.

A large number of species of fish occur in the region, many of which may be ecologically or commercially significant, including sharks of various species (such as the whale shark that may pass Port Hedland during migration).

Auditory criteria for injury and disturbance caused by acoustic energy for these faunal groups have been a focus of much scientific work in recent years. The work, however, has resulted in criteria limited to mainly cetaceans, pinnipeds (seals and sea lions), and fish. Criteria are not yet available for dugongs.

Auditory criteria for potential noise impacts upon individual organisms have been categorised into the following order based on degree of severity, from highest to lowest:

1) Organ damage: physiological damage which may lead to death;
2) Permanent Threshold Shift (PTS): a permanent shift in hearing sensitivity;
3) Temporary Threshold Shift (TTS): a temporary effect upon hearing (i.e. recoverable); and
4) Behavioural responses: which may span short term startle responses to long term avoidance of areas by animals or a change to movement pathways or migration routes. These responses also include those resulting from masking of signals of interest.

Impacts for pile driving (the source with the greatest level of estimated direct impacts based on the high peak levels involved) within the severity classes described above are expected within the following radii:

- injury/death: within several to tens of metres from the source;
- PTS: within tens of metres from the source;
- TTS: within 200 m from the source; and
- behavioural disturbance: within 2 km to tens of kilometres, depending upon the species, habituation or sensitisation and severity of the behavioural response considered.

Impact Assessment

Potential impacts on marine environmental receptors due to noise emissions associated with the Outer Harbour Development and proposed management measures are discussed in the following sections:

- **Section 10.4** – Marine fauna
- **Section 10.6** – Avifauna
- **Section 11.9** – Commercial Fisheries.

8.3 Marine Discharges

8.3.1 Overview

Discharges to the adjacent marine environment may occur during construction and operation of the Outer Harbour Development. Nearshore marine construction activities which will cause emissions of sediment (primarily dredging and piling related to the new dredged channel, wharf and jetty) are described in **Section 2.5**. Impacts are discussed in **Section 10**. During operation marine discharges will largely be restricted to stormwater releases, being discharged through BHP Billiton Iron Ore's existing port surface water drainage network. There will also be releases of ballast water from shipping activity.

8.3.2 De-watering

Dewatering of approximately 8 ML per day for a period of 16 months is likely to be required during excavations and construction activities associated with the car dumpers. Reuse options for this water will be evaluated, however, if disposal of part or all of the water is required, water will be discharged in accordance with guidelines into Salmon Creek.

8.3.3 Stormwater

Stormwater discharge occurs during every storm event, when large quantities of rainwater mix with soils and iron ore across site and enter the stormwater drains which flow into the harbour. During storm events, natural runoff will also occur where water from surrounding areas drains into the local creek systems and is released to the harbour. Naturally occurring discharge is known to create visible sediment plumes in the harbour.

Given the semi-arid nature of the Port Hedland area and the region's erratic rainfall, stormwater discharges will be restricted to short-lived high flow events following cyclonic rainfall or seasonal thunderstorm activity. Such flows, if not properly managed, have the potential to exacerbate soil erosion, increase turbidity levels in surface waters and carry contaminants (i.e. hydrocarbons) into the marine environment resulting in decreased water quality and adverse impacts to marine fauna.

Further discussion of discharge water quality, the potential impacts to the environment and planned management measures are included in **Chapter 10**.

8.3.4 Ballast Water

Vessels and structures arriving from overseas locations are required to exchange 95% of their ballast water outside Australian territorial waters in depths greater than 200 m in line with an approved Ballast Water Management Plan. Compliance with this regulation is administered by the Australian Quarantine and Inspection Service (AQIS).

Ballast water will be discharged into nearshore waters during ore loading activities to maintain vessel stability in line with Australian and international (MARPOL) regulations. This water will be clean seawater, isolated from bilge water and is not expected to have an adverse environmental impact upon discharge. Bilge water from dedicated service vessels will be handled by third party service providers for treatment and disposal. The facility will not receive bilge water or grey water from third party vessels arriving at the port.

8.3.5 Sewage

Sewage from dredging or support vessels will be either discharged outside of Western Australia Coastal Waters (>12 nm) in accordance with MARPOL Convention 1973/1978 and the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*, or will be contained and taken onshore for treatment by the onsite facilities or a licensed contractor.

8.4 General Waste

8.4.1 Overview

A variety of solid and liquid wastes, requiring safe disposal, will be produced during the construction and operation of the Outer Harbour Development. The generation of waste will be managed and minimised through a waste hierarchy program. Any waste products will be handled and disposed of in an acceptable manner. No controlled waste (as defined by the *Environmental Protection [Controlled Waste] Regulations 2004*) will be discharged to the environment.

8.4.2 Types and Volumes of Waste Generated

Quantities and types of waste generated during construction will be highly dependent upon the construction methodology. Any inert material (soil, rock etc) generated during site preparation will be re-used. Apart from relatively small volumes of domestic and green waste, volumes of packaging waste (plastic, paper, timber etc) will be generated. Key liquid wastes generated during construction may include solvents, chemicals, sewage, grey water, waste oils, oily waste water, paint and contaminated waste water. Construction of the overall development is estimated to take approximately 8 years progressing from Module 1 to Module 4. **Table 8.9** provides a list of key solid and liquid waste types and indicative quantities that will be generated throughout the construction phase of the project.

Operation activities associated with the Outer Harbour Development will result in the generation of a variety of liquid and solid wastes, some of which may be hazardous (to human health and the environment), as a result of routine servicing and maintenance and will require routine discharge and treatment. Key solid wastes generated during operation may include empty containers, recyclable material and used batteries. Key liquid wastes generated during operation will be the same as those generated during construction of the Outer Harbour Development. Typical solid and liquid wastes generated during the operational phase, including those that are hazardous, are presented in **Table 8.10**.

Table 8.9 – Indicative Inventory of Construction Solid and Liquid Waste Types for the Outer Harbour Development

Description	Activity/Source	Estimated Quantity (total per year)	Frequency of Generation
Solid Wastes			
Green waste, soils and rock (no acid sulphate soils (ASS))	Clearing, earth works, dredging	Largely variant	During construction
Soils and rock with ASS*	Clearing, earth works, dredging	To be determined in ASS study(1)	During earthworks and dredging
Municipal Waste	Marine vessels, vehicles, infrastructure construction, maintenance.	Approximately 600 t	Weekly
Empty contaminated containers including paints, solvents, etc*	Construction of infrastructure	>100 m^3	Weekly
Hydrocarbon waste including grease, spill cleanup material, etc*	Marine vessels, vehicles, infrastructure construction	100 m^3	Weekly
Empty drums and containers	Marine vessels, infrastructure construction, Maintenance	Approximately 300 drums	Monthly
Recyclable material including cardboard, paper, aluminium cans, glass, scrap metal etc.	Office buildings, workshops, construction	< 500 t	Weekly
Batteries*	Maintenance	< 5 t	Monthly
Scrap Metal	Infrastructure construction	Approximately 400 t	Weekly
Liquid Wastes			
Spent solvents, chemicals*	Painting, workshops, infrastructure construction, marine vessels	< 1500 L	Bi-Monthly
Sewage and grey water*	Marine vessels, office buildings	Approximately 146 ML(2)	Daily
Waste oils, oil sludges*	Marine vessels, vehicles, infrastructure construction	120,000 L(32)	Weekly
Paints*	Marine vessels, infrastructure construction	Largely variant	Largely variant
Oily waste water / contaminated waste water*	Marine vessels, vehicles, infrastructure construction	Largely variant	Largely variant

**Hazardous Waste*

1) For excavation quantities refer to the Preliminary Site Investigation and Potential Acid Sulphate Soil Investigation reports. (see Appendix B112*)*

2) Based on an estimate of 200 L of water per person per day (figure calculated on approx 2000 (peak) people onsite for 365 days (not including accommodation). Total volume is largely dependent on workforce numbers (BHPBIO, 2008f).

3) Estimate is based on the assumption that majority of vehicles are serviced off-site. Workshop numbers are unknown.

Table 8.10 – Indicative Inventory of Operational Solid and Liquid Waste Types for the Outer Harbour Development

Description	Activity/Source	Quantity (total per year)	Frequency of Generation
Solid Wastes			
Green waste	Clearing, earth works, dredging	Approx 600t	Monthly
Aluminium cans	Office buildings, workshops	7 t	Monthly
Municipal waste	Office buildings, workshops, marine vessels.	24,000 t	Weekly
Empty contaminated containers (paints, solvents, etc*	Laboratory, workshops, maintenance	>100 m^3	Weekly
Pallets/treated timber	Laboratory, workshops, maintenance	1,000 t	Monthly
Hydrocarbon waste including grease, spill cleanup material, etc*	Marine vessels, workshops	1,700 m^3	Monthly
Oil filters*	Workshops	2,800 m^3	
Empty drums and containers	Marine vessels, workshops	Approx. 2,600 drums	Monthly
Recyclable material including cardboard, paper, aluminium cans, glass, scrap metal etc	Office buildings, workshops, packaging	< 350 t	Weekly
Batteries*	Workshops	Approx 1,060 t	Monthly
Scrap metal	Workshops	26,000 t	Monthly
Scrap rubber	Workshops, maintenance	600 t	Monthly
Liquid Wastes			
Spent solvents, chemicals*	Marine vessels, workshops, maintenance	< 1,300 L	Monthly
Sewage and Grey Water*	Marine vessels, office buildings	22 ML(1)	Daily
Waste oils, oil sludges*	Marine vessels, workshops	140,000 L	Weekly
Oily waste water* / Contaminated waste water	Marine vessels, workshops	52 ML(2)	Bi-monthly
Oily waste water (Recycling)*	Workshops, wash bays.	15,000 kL	Monthly
Paints*	Marine vessels, workshops, maintenance	Largely variant	Largely variant

** Hazardous Waste.*

1) Based on an estimate of 200 L of water per person per day (figure calculated on 300 people onsite for 365 days) (not including accommodation). Total volume is largely dependent on workforce numbers.

2) Estimate is based on the assumption that majority of vehicles are serviced off-site. This is based on a total number of 11 workshops including locomotive, electrical and mechanical workshops.

8.5 Accidental Releases (spills and leaks)

If not appropriately managed, hydrocarbons and hazardous materials have the potential to adversely impact the environment. The handling of hydrocarbons increases the risk to the environment in the event that a spill or leak occurs. Such spills may lead to atmospheric, ground or water contamination and also have the potential to disrupt recreational activities and result in reduced aesthetics. Hazardous substances to be utilised during the construction and subsequent operation of the Outer Harbour Development will largely be confined to stationary plant, equipment and vehicles and comprise diesel fuel, oils and grease.

Spills and leaks may occur throughout the life of the Outer Harbour Development. The impact of any spill or leak will depend on the volume and toxicity of the material released and the nature of the receiving environment.

Iron ore dust will be emitted into the marine environment from the conveyor systems, the access roadway, the access walkways, shiploaders and shiploader rail system. This will be readily dispersed into the marine environment, and expected discharges will be small in the context of any likely impact.

Spills of hydrocarbons and hazardous materials may result from transport accidents, or from handling and storage. Diesel refuelling of iron ore ships and support vessels will be carried out using transfer hoses fitted with "dry break" couplings. Dredgers and other marine vessels are likely to be supplied with chemical reagents and diesel fuel on a regular basis. Chemicals may include lubricants but are not limited to, disinfectants, heating oils, detergents, various acids and alkalis. Transfer of reagent and waste chemicals between the construction vessels and the land based facilities will be managed in line with appropriate legislation and guidelines. Spills will be recovered by excavation of contaminated soil and remediation, where applicable. Spills that occur outside bunded compounds will be recovered. Clean up equipment and absorbent materials will be stored adjacent to storage facilities, to allow rapid spill response.

Leaks of hydrocarbons and hazardous materials may occur due to equipment failures during handling, transfer and storage. The majority of leaks are likely to occur within bunded compounds. Leaks which occur outside bunded areas will be recovered.

Impact Assessment

Potential impacts to the environment associated with transfer of chemicals and wastes and associated management strategies are discussed in **Section 10**.