5.2.2 Surrounding Land Use

The incinerator site is located within the East Arm Precinct that is dedicated to industrial uses. The surrounding land uses are primarily industrial (Table 2 and Figure 5-4). The Business Park Industrial area on Berrimah Road leads into the East Arm Wharf. This area includes a fuel storage area, quarry and a train terminal that is utilised by both commercial industry and the general public.

The East Arm public boat ramp is located to the east of the entrance gate to the East Arm Wharf. This ramp can have a medium traffic flow and become crowded with cars and boating trailers that can overflow onto Berrimah Road.

To the northeast is Kormilda College (5.7 kilometres in a straight line), a secondary high school on Berrimah Road that has over 900 enrolled students and a staff of 180. To the east is Palmerston city (7.5 kilometres in a straight line) and to the northwest is Darwin city (7 kilometres in a straight line). The population of Darwin city and Palmerston city is approximately 70,000 and 24,000 respectively (ABS 2006).

Charles Darwin National Park is located to the north of the incinerator site and is an important reserve. The park protects significant Indigenous and Non-Indigenous historical sites, as well as a vast stand of mangroves and woodland. Mangroves form part of the nationally significant wetland that is recognised to exist in Darwin Harbour.

The Wickham Point $1.6 billion LNG Plant is located to the south of the project site. The plant is connected via a 500-kilometre pipeline to the Bayu-Undan gas field in the Timor Sea. Large gas tankers require access to the plant using the wharf to load the LPG.

Table 2 Surrounding Land Use

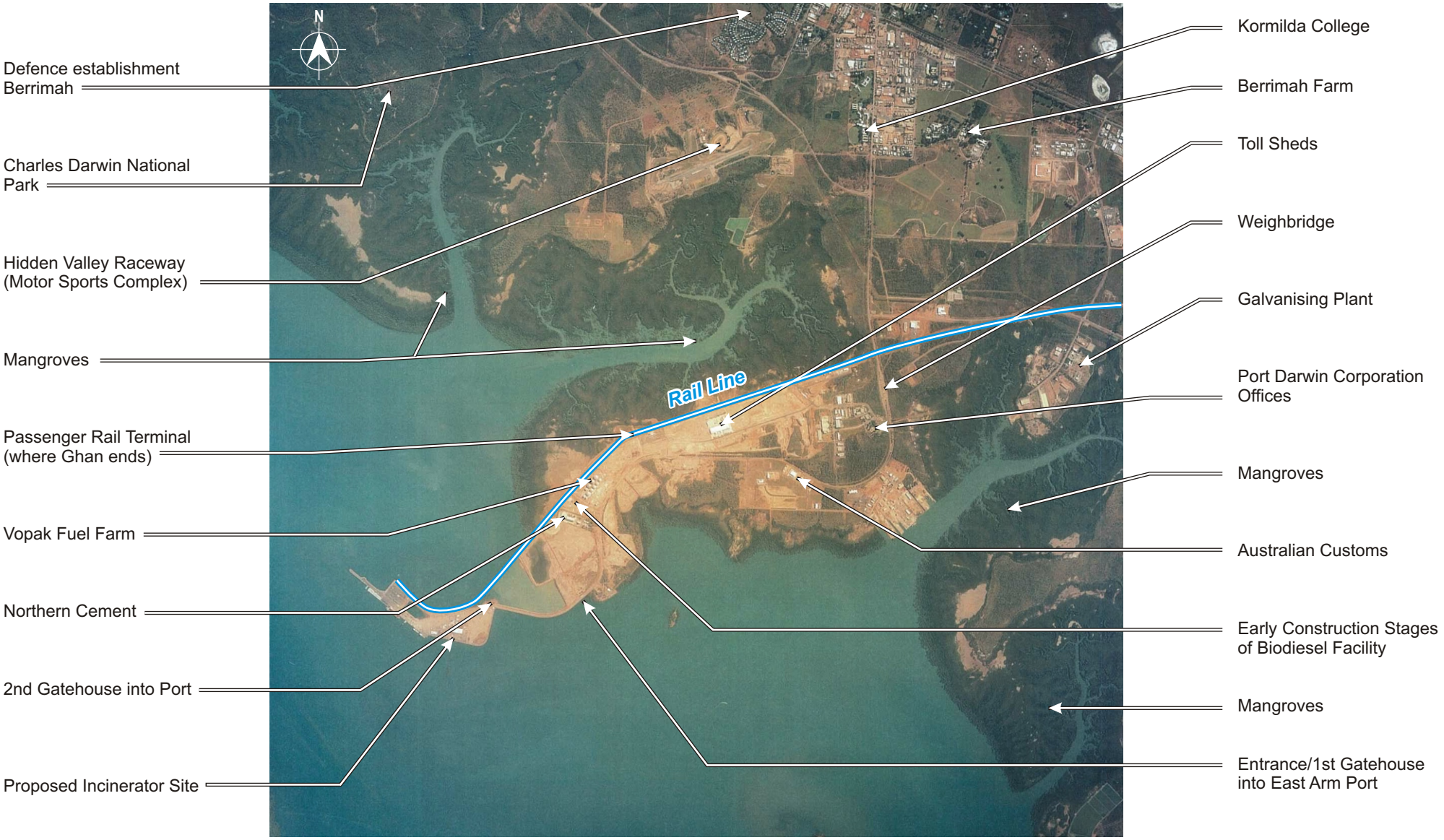
Direction	Land Use
North	Charles Darwin National Park, Berrimah Industrial Area, Darwin Airport and Kormilda College to the north east (8 kilometres by road)
East	East Arm Boat Ramp, Darwin Business Park Industrial site including the quarry and train terminal, and Palmerston city (11 kilometres by road)
South	Wickham Point LNG Plant
West	Darwin Harbour and Darwin City (22 kilometres by road)

5.2.3 Potential Impacts

The construction and operation of the quarantine waste facility will be in keeping with the surrounding land uses and land capability. The incinerator will not affect the amenity of the current environment at East Arm Wharf.

5.2.4 Mitigation Measures

The Construction and Operation Environmental Management Plans will incorporate any mitigation measures that will be taken to ensure public amenity is protected.



Source: Aerial Photograph Northern Territory Government.

GHD CLIENTS | PEOPLE | PERFORMANCE

Quarantine Waste Treatment Facility Public Environmental Report

Land Uses in the Vicinity of the Proposed Quarantine Waste Facility

scale | date | 11 August 2006

job no 43-20914
file ref 43209142_LTN_01.cdr

Figure 5.4

Level 5, 66 Smith Street, Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **W** www.ghd.com.au

5.3 Climate

5.3.1 Existing Environment

Local Climate

Darwin is subject to a tropical climate consisting of a wet and dry season. The dry season extends from approximately March to September, and displays moderate temperatures, low humidity and winds predominantly from the east. The wet season occurs for the remaining months and tropical cyclones, thunderstorms and monsoon rain are common, in association with high temperatures and humidity. During the wet season, winds are predominantly from the west.

Site-specific meteorology and atmospheric stability will display a marked influence on the transport and dispersion of emissions to air, and consequent predicted ground level concentrations. For example, the presence of an inversion, where a layer of stable air caps a near-ground neutral or unstable layer, will limit the upward movement of warm rising air that would normally assist in pollutant dilution and removal.

Meteorology

The transport and dispersion of the emissions to air from the proposed incinerator will be influenced by prevailing synoptic flows, local sea breezes, and vertical temperature profiles that will alter both diurnally and with wind direction, depending on whether flows are coming off the land or water.

Annual Distribution of Wind Direction and Stability at East Arm Wharf

The pattern of wind climate is readily shown by means of a wind rose. The annual wind rose formed from the Darwin East Arm Wharf data is provided in Figure 5-5.

Figure 5-5 shows the dominant wind regimes to be flows from the west (with an occurrence of approximately 9%), west-northwest (approximately 11%) and easterly directions (approximately 9%). Consistent flows from the northern sector are also evident with a maximum occurrence of approximately 7%. Flows from the south are least prevalent, with a particularly low frequency of southeasterly winds at approximately 5%.

Higher wind speeds are clearly evident during flows from the west whereas flows from the south display the lowest speeds.

Seasonal Distribution of Wind Direction at East Arm Wharf

The wet and dry seasons occurring in Darwin display different wind patterns. Figure 5-6 illustrates seasonal wind roses for Darwin East Arm Wharf.

The wet season shows strong onshore winds from west and northwest component directions (occurring approximately 15% and 25% respectively) and minimal winds from the east and south. The dry season displays contrasting flow conditions when compared to the wet season whereby strong offshore winds from the east and southeast component directions are visible at approximately 15% and 20% respectively. Similar frequencies of northerly component flows are evident during the dry and wet seasons (approximately 15% in both cases).

5.3.2 Potential Impacts

Construction and operation of the quarantine waste facility is very unlikely to affect local or regional climate conditions.

5.3.3 Mitigation Measures

A Construction and Operation Environment Management Plan will be developed for the proposed incinerator, which will incorporate measures for the construction and operation of the incinerator during extreme weather events.

Figure 5-5 Annual Wind Rose for Darwin East Arm Wharf

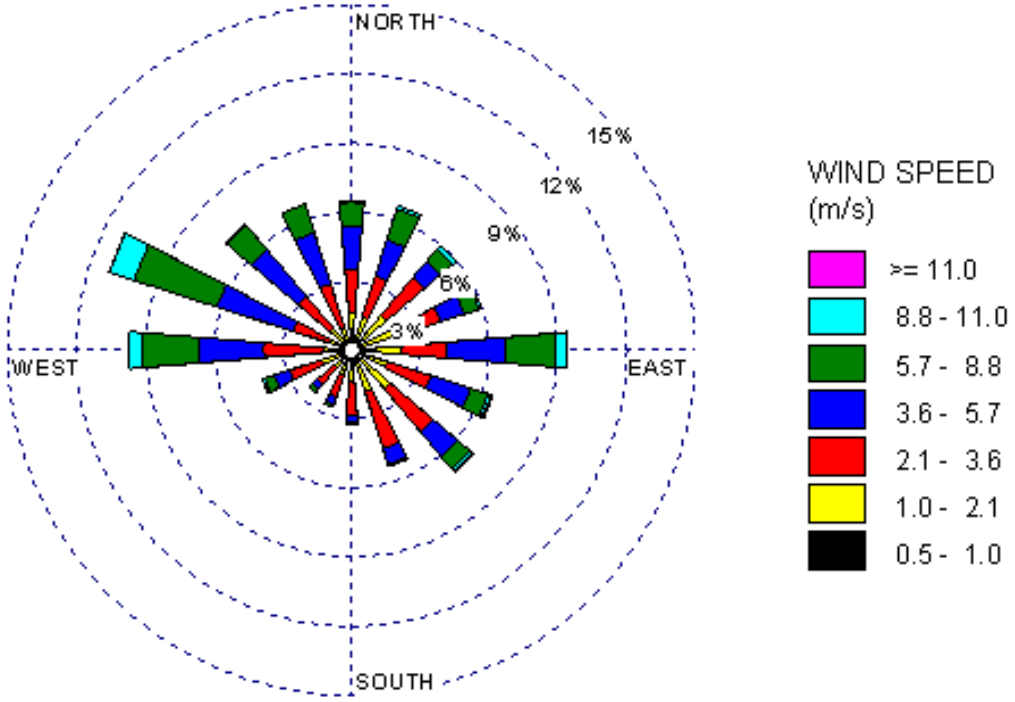
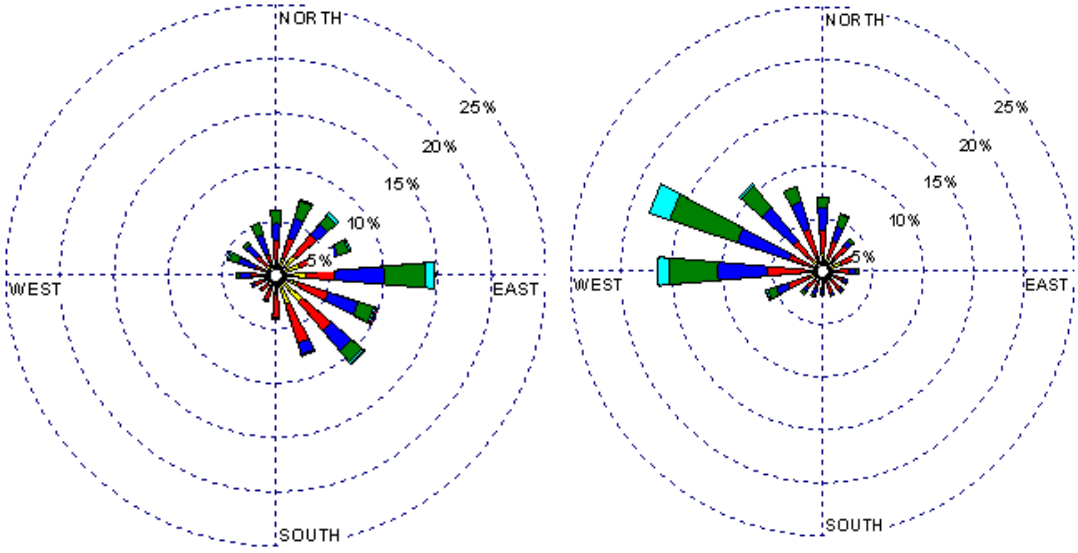


Figure 5-6 Seasonal Wind Roses for Darwin East Arm Wharf (legend as above)



Dry Season Wind Rose **Wet Season Wind Rose**

5.4 Landform

5.4.1 Existing Environment

Two major landforms comprise the area; the bustard and littoral systems (URSb 2005). The bustard land system forms the hinterland and hinterland margin and is characterised by rolling hills forming a low plateau rising to 24m. The slopes are gentle (2 to 5%) and relief is up to 10m. On the lower slopes a laterite profile has been formed while on the upper slopes the soils are lithosoils. The lithosol soils have high gravel content (40 to 70%) and are shallow with sandy textures resulting in excellent drainage making them poor for urban or extensive agricultural use (URSb 2005). The texture of the lithologies range from siltstones and sandstones to coarse quartz conglomerates (URSb 2005).

The littoral land system forms the fringe and is dominated by the mangrove community. Topographically the littoral land system has negligible relief and slope and is inundated at peak tides. The mangroves grow in a mud substrate, dominantly made up of clay materials and quartz silt (URSb 2005).

When the Wharf was constructed fill was taken from an undeveloped hill in the surrounding area and as such DPC considers the fill to be free of contaminates. The wharf was constructed with clean fill and a thick top covering of road base material from a local quarry followed by a bitumen top covering.

The East Arm Port has been developed through the reclamation of land. The process of settling of this land was recorded for 30 months for a period ending 30 June 2002. The results indicated that there was 48 mm of settling that occurred during this time (pers comm. DPC). It is expected that the bulk of settlement on site has occurred prior to the construction of the incinerator.

Acid Sulphate Soils typically occur in coastal areas such as coastal floodplains, swamps, saltwater lagoons, in environments rich in sulphate, iron and organic matter and typically in areas less than five metres AHD.

Acid sulphate soils conditions are formed by the combination of iron with sulphate to produce pyrite under oxygen deficient conditions. When exposed or drained, the pyrite oxidises to form sulphuric acid.

The presence of acid sulphate soils in surrounding mangrove mud areas surrounding the wharf, that are not constructed of fill material, is likely.

5.4.2 Potential Impacts

Contaminated Land

It is anticipated that the construction of the proposed incinerator will temporarily disturb only the surface layer of the fill (which exists to a depth of approximately 3-4 m) used to create the Wharf, and the natural soil will not be disturbed. Given that the DPC considers this fill material to be clean, it is highly unlikely that there will be potential impacts associated with contaminated land providing no excavation into natural material is made. During the construction phase it is anticipated that only shallow disturbance of the land will be required, that will only affect the bitumen surface and the subsurface road base.

The quarantine waste facility will be installed on a hardstand area with appropriate bunding. During the operation phase, ash and other potential contaminants such as petroleum from trucks has the potential to fall on the bitumen surface/hardstand area. Penetration of the hardstand area and therefore contamination of the soil underneath is unlikely.

Ash has the potential to be dispersed during the transportation from East Arm Wharf to the landfill if not correctly secured.

Acid Sulphate Soils

If an alternate construction method is selected the development could potentially require excavation into marine muds and in turn cause exposure of Acid Sulphate Soils (ASS).

It is highly unlikely that excavation into marine mud will be necessary during construction of the incinerator.

5.4.3 Mitigation Measures

In the event excavation into marine mud is required an Acid Sulphate Management Plan is needed. Material stockpiled during excavation will need to be appropriately controlled and disposed of or reburied. Fill that may be imported onto the site during construction will be certified as “clean”.

Sediment traps will be installed to prevent soil runoff into Darwin Harbour.

5.5 Water

5.5.1 Existing Environment

Surface Water

A north-south trending ridge that can control runoff dominates the area surrounding the incinerator site. Well-developed drainage channels are absent from the area as the catchment area is small (URSb 2005).

East Arm Port has a series of stormwater drains established on site that run northwest-southeast, north of the incinerator site. The current stormwater management at East Arm Wharf consists of a series of stormwater collection pits that exit the site at various points into the ocean.

The interim incinerator, located next to the site of the proposed incinerator, has a dedicated triple interceptor before discharge to stormwater. The surface water collected in dedicated wash down and/or transit areas on-site will be discharged to sewer via the interceptor. The drainage for the proposed incinerator will run into this existing interceptor, which will be re-directed to sewer.

Groundwater

Groundwater at the East Arm Wharf is not naturally occurring and is most probably the infiltration seawater. The water levels are tidal influenced ranging in around approximately eight metre fluctuations per day, depending upon tidal patterns. Groundwater levels can be assumed to be equal to that of the seawater level. Given the shallow excavation depth associated with construction, contact with such water bodies is not likely.

Surrounding Aquatic Environment

The East Arm of Darwin Harbour is the estuary of the Elizabeth and Blackmore Rivers. It experiences daily and seasonal fluctuations in salinity depending on the rate of recent freshwater inflows and tidal stage. The runoff contains suspended particles, inorganic and organic nutrients, waste derived from the developed and undeveloped sections of the catchment as well as effluent from the wastewater treatment lagoon at Palmerston and Berrimah. This is discharged in the tidal tributaries of East Arm (URSb 2005).

The tidal range in Darwin Harbour is approximately eight metres making it amongst the highest on the Australian coast. The extensive tidal water movement has a significant influence on the shape, seabed characteristics, current dynamics and water quality (ibid).

The extensive water movement results in large areas of Darwin Harbour existing in two different environments. Areas are sometimes covered with up to eight metres of seawater at high tide and exposed to sunlight, air, and high temperature during low tide (ibid).

The seabed around the proposed area is similar to the other regions of Darwin Harbour. It is characterised by a diverse mosaic of intertidal mudflats, coral rubble banks and reef rock, sand banks, rocky islands, coral rubble slopes and channel beds, and muddy and sandy seabeds making available a variety of marine habitats to the biota at various depths (ibid).

The turbidity of Darwin Harbour is naturally quite high due to suspension and re-suspension of sediments from the extensive mud flats by tidal currents, wind, waves and from suspended particles in storm runoff. The high turbidity restricts the amount of light that can reach depth, and hence is the major factor limiting primary productivity in Darwin Harbour (ibid).

5.5.2 Potential Impacts

During site preparation, excavation of the soil will occur near the surface. It is highly unlikely groundwater will be intercepted during construction and operation.

Accumulation of particulate matter in surface waters and any deposition in the nearby aquatic environment would be diluted and dispersed such that any negligible impacts would not be discernible. As such effects on possible sources of food and their contamination by emissions or the depositions of particulates is very unlikely given the size of the sources and the extent of the local environs.

Water Balance

The incinerator will consume up to 500 L/hr of potable water in the adiabatic quench designed to reduce gas temperatures rapidly to avoid the formation of dioxins via de novo synthesis. The gases will be rapidly cooled from the afterburner to about 200°C so that they can be passed through the dry scrubbing system. The adiabatic quench will not produce any waste water as it will all evaporate within the gas stream.

Waste Water

Waste water will be produced from bin washing. High-pressure hot water or a steam lance is used to sanitise bins before they go back into recirculation. This involves minimal water use, but is dependent on the number of bins to be cleaned. The waste water would be suitable for discharge to sewer but some of it may also be utilised in the quench (during which it will be evaporated).

Quality of Adjacent Aquatic Systems

The construction of the site will occur in the dry season over a small site area of approximately 40 m^2. There is unlikely to be significant rainfall during the construction period and site water generated will be treated through sediment traps and oil/water separation before discharge. Only minimal quantities of standard construction chemicals, oils and fuels will be stored on site for daily use. Chemicals, oils and fuels will be stored in temporary bunded areas and a spill management plan with supporting spill control equipment will be implemented. Acid Sulphate soils will be controlled through appropriate stockpiling, removal and/or reburial strategies and will therefore not migrate to surrounding aquatic systems. Given

the above controls it is not considered that any significant contaminants will travel to the surrounding marine, surface or groundwater environment. The frequency of contamination entering the surrounding aquatic environment is considered unlikely and the resulting consequence/severity is considered insignificant.

Any deposition from stack emissions in water will have a minimal effect due to tidal effects and wet season flushing of the harbour, effectively creating infinite dilution. Therefore, any sea-based food is unlikely to be impacted.

5.5.3 Mitigation Measures

During the construction of the incinerator appropriate measures will be included in the Environmental Management Plan. These include:

- Control of hazardous chemicals including oils and fuels through minimal stockpiling and storage techniques;
- Maintenance of an oil and spill response kit, provided by Darwin Port Corporation;
- Daily visual monitoring of Darwin Harbour adjacent to the site to identify any visible pollution or plumes; and
- Completion of an acid sulphate soils management plan if there is a change of construction method that may include excavation into potential acid sulphate soils.

During the operation of the incinerator appropriate mitigation measures will be included in the Environmental Management Plan. These include:

- Correct storage of hazardous chemicals and materials, including regular auditing of storage areas;
- Maintenance of an oil and spill response kit;
- Cleaning up of spillages of chemicals and oils (using an oil and spill response kit) as quickly as practicable;
- Regular inspection and clean out of stormwater sumps and interceptor pits;
- Maintenance of drainage systems in the truck loading areas and undertaking of visual inspections of these after first-flush events or heavy periods of rain; and
- Immediate removal of any material which enters Darwin Harbour as a result of incinerator operations.

5.6 Noise

Noise monitoring and assessment were undertaken to determine ambient noise levels and to assess the acoustic impact of the proposed quarantine waste treatment incinerator.

The basis of the assessment was to ascertain whether the proposed facility would have an acoustic effect on the amenity of residences living in close proximity of the site, during both construction and operation of the waste facility.

5.6.1 Criteria

At present, there are no environmental noise regulations for the Northern Territory. The EPA has drafted noise guidelines for the Northern Territory primarily based on NSW noise regulations and guidelines (pers comm. EPA). However, the draft guidelines are in the process of being finalised and approved and were not available for this project.

Due to the NT Guidelines primarily being based on NSW guidelines, for this study NSW Department of Environment and Conservation (DEC) publications, Environmental Noise Control Manual (ENCM) and the Industrial Noise Policy (INP) have been used as a frame of reference.

5.6.2 Methodology

Unattended noise monitoring was undertaken to determine existing background noise levels (ambient noise environment) in the vicinity of the proposed waste incinerator.

The nearest sensitive noise receivers to the proposed facility were identified as:

» Government House, located approximately 5.5 kilometres north west of the site, across Frances Bay; and

» Kormilda College, located to the north east of the proposed site.

Noise monitoring was also conducted at East Arm Wharf to determine existing ambient noise levels.

Detailed noise modelling was undertaken based on provided sound power levels of primary noise sources for the proposed facility. The detailed noise assessment is provided in Appendix F.

Operational modelling for the incinerator was undertaken based on information provided from a similar waste facility located in Malaysia, using CadnaA software under differing meteorological conditions.

Modelling was based on a worst-case scenario, with more than one activity occurring simultaneously.

5.6.3 Existing Environment

Calculated background day, evening and night time noise monitoring results for the three locations are provided in Table 3.

Table 3 Average Noise Monitoring Results

Location	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am
1. Government House	42.6 dB(A)	38 dB(A)	41.8 dB(A)
2. East Arm Wharf	30.9 dB(A)	32.3 dB(A)	30.8 dB(A)
3. Kormilda College	45.4 dB(A)	45.8 dB(A)	39.4 dB(A)

5.6.4 Potential Impacts

Based on the distance attenuation to determine the anticipated total received noise at the nearest sensitive noise receivers during construction of the proposed facility, and taking into consideration the anticipated duration of construction activities, it is unlikely that construction noise will exceed the specific

construction noise criteria and is therefore unlikely to have an adverse impact on the existing acoustic environment.

Results of the noise modelling indicate that operational noise has the potential to meet project specific noise goals at the modelled locations, Government House and Kormilda College under differing meteorological conditions during day, evening and night time periods.

Modelled results suggest that the noise levels generated by the proposed facility are well below the adopted noise levels.

Table 4 Construction Noise Criteria (L_{10})

Construction Period	Level Restrictions	Location 1 – Government House	Location 3 – Kormilda College
Less than 4 weeks	Background + 20 dB	63	70
Less than 26 weeks	Background + 10 dB	48	60
More than 26 weeks	Background + 5 dB	46	49

Table 5 Operational Project Specific Noise Levels

	Location 1 – Government House			Location 3 – Kormilda College		
Criterion	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am
Background Level	43 $L_{A90(day)}$	38 $L_{A90(evening)}$	41 $L_{A90(night)}$	45 $L_{A90(day)}$	46 $L_{A90(evening)}$	39 $L_{A90(night)}$
Project Specific Noise Level	**43** $L_{Aeq(15min)}$	**38** $L_{Aeq(15min)}$	**40** $L_{Aeq(15min)}$	**50** $L_{Aeq(15min)}$	**45** $L_{Aeq(15min)}$	**40** $L_{Aeq(15min)}$

The modeling of the acoustic impacts demonstrates that the operation of the incinerator would not be heard at the sensitive receptors.

5.6.5 Mitigation Measures

No specific mitigation measures or management plans are required for the operation of the facility.

A general noise management plan has been incorporated into the Construction and Operational Environmental Management Plans (Appendix J and K) and includes any necessary near noise limits and noise minimisation technology.