7. EXISTING SOCIAL ENVIRONMENT

7.1 EUROPEAN HERITAGE

The Frances Creek region was first 'explored' by McKinlay in 1866 (Levitus, 1995) although significant settlement of the area didn't occur until the Gold Rush of the late 1800s.

The township of Pine Creek, 30 kilometres from the project area, was the main settlement during this time. Its population exceeded 3,000 during the 1890s. The initial rush of the 1870s was bolstered by construction of the railway line from Darwin which reached Pine Creek in 1888 (Flinders Ranges Research, 2005).

Mining did not occur at Frances Creek during the Gold Rush of the late 1800s. The mine site is instead part of a second phase of mining which occurred between 1950 and 1974. This new boom for the area was based on iron ore and uranium mining. Iron ore was mined at Frances Creek from 1966 until 1974 with eight million tonnes of ore produced (Flinders Ranges Research, 2005).

Mining began to decline during the early 1970s as demand from international markets weakened. Tropical Cyclone Tracey in 1974 resulted in extensive flooding and damage to infrastructure, both in Darwin and Frances Creek. Damage ultimately led to closure of the Darwin-Pine Creek Railway and closure and abandonment of the Frances Creek mine.

A search of the Australian Heritage Database in June 2006 showed no registered sites within the Frances Creek area.

A search of the Northern Territory Office of Environment and Heritage Archaeological Resource Database was conducted for the Pine Creek 1:250K map sheet. No registered historical sites were recorded in the Frances Creek area.

Mr Tim Hill completed an archaeological survey of the Frances Creek project area. The survey report is included as Appendix 10.

Seven historical areas from the original Frances Creek mine were recorded during the survey. The only intact building recorded was the old Frances Creek church. Only concrete pads and building materials remain from other buildings. The most commonly-encountered sites during the archaeological survey were rubbish tips and metal dumps.

The only heritage site considered to have obvious heritage potential is the Frances Creek Railway (Hill, 2005).

7.2 ABORIGINAL HERITAGE

The Frances Creek project area is in Jawoyn country, which extends south to Katherine and east into Kakadu National Park. The traditional owners identify themselves as Munggay people.

The nearest Aboriginal community is located at Kybrook Farm, approximately four kilometres south of Pine Creek. Residents identify as Jawoyn, Wagaman, Agicondi, Arigoolia people. The Aboriginal population of the Pine Creek region is about 130 (Pine Creek Community Council, 2006).

A search of the Northern Territory Office of Environment and Heritage Archaeological Resource Database was conducted for the Pine Creek 1:250K map sheet. No Aboriginal archaeological or registered historical sites were recorded in the Frances Creek area.

The Aboriginal Areas Protection Authority (AAPA) has a record of an Aboriginal site within AN 389. This is outside the proposed mining areas.

Mr Tim Hill, accompanied by Bessie Coleman, completed an Aboriginal sites survey of the Frances Creek project area between 17 and 21 October 2005. The survey report is included as Appendix 10.

A total of eight Aboriginal archaeological sites were recorded during the survey (Table 22). These sites are considered to have low to moderate significance (Hill, 2005) due to the extent of existing disturbance and presence of a relatively intact site complex at Mt Porter, approximately five kilometres to the south-west.

Table 22: Aboriginal Sites Recorded from the Frances Creek Project Area

Name	Landform	Distance to Water (m)	Estimated Size (m^2)	Est. Max Density	Est. Ave. Density	Est. Diversity	Artefact Types
Frances Creek 1	Creek bank	10	4,900	4	1	3	Flakes, formed blades
Frances Creek 2	Creek bank	2	68,300	8	0.5	4	Flakes, formed blades, steel blade, knapping floor.
Frances Creek 3	Creek bank Lower slope Hilltop	2	45,700	30	1	6	Flakes, formed blades, debitage, cores. Distinct knapping/reduction area.
Frances Creek 4	Lower slope	50	18,200	2	0.2	3	Flakes, formed blades
Frances Creek 5	Alluvial plain	10	7,900	3	0.5	3	Flakes, formed blades
Ochre Hill 1	Hilltop	300	3,200	5	0.2	4	Flakes, formed blades
Ochre Hill 2	Lower slope	5	2,700	2	0.2	3	Flakes, formed blades
Ochre Hill 3	Alluvial plain	5	5,200	1	0.1	3	Flakes, formed blades

Territory Iron is in the process of obtaining an AAPA Authority Certificate for the Frances Creek Project. This certificate will be finalised and all conditions adhered to before any mine development.

7.3 NATIVE TITLE

The project area is subject to Native Title Claim NTD6021/01 by the Northern Land Council which is yet to be resolved. Territory Iron has entered into discussions with the traditional owners via the Northern Land Council and reached an agreement on Aboriginal site and heritage protection, employment opportunities, mine site rehabilitation, and financial compensation when mining begins.

7.4 SOCIAL ENVIRONMENT

The Frances Creek project area is 30 kilometres north of Pine Creek, which is the nearest population centre. Pine Creek is on the Stuart Highway between Darwin and Katherine. Pine Creek district covers an area of 400 square kilometres and has a population of about 500 people of which 10% are Aboriginal (ABS, 2002).

Major industries in the district include agriculture (beef and cattle), mining and tourism. Tourism sites feature the unique landscape, Aboriginal heritage, flora and fauna in the world heritage listed Kakadu National Park, 50 kilometres north-east of Pine Creek.

Review of the 2001 census figures showed that:

- The population of Pine Creek and surrounds was 472 with about 10% of the population identified as Aboriginal or Torres Strait Islander.
- The Pine Creek population is older on average than Northern Territory and Australia as a whole with a median age of 36 compared with 30 for the Northern Territory.
- About 42% of the Pine Creek workforce is employed in the mining industry. The second largest industry in Pine Creek is accommodation, cafes and restaurants, employing 14% of the workforce.
- Pine Creek had a higher percentage of adult males in full time employment (76%) than the Northern Territory as a whole. Other towns in the Northern Territory with high levels of employment are also mining towns.
- About 44% of the population over the age of 15 has post-school qualifications.
- The median weekly personal income is $600-699, which is greater than the Northern Territory median weekly personal income in the $500-$599 range.

The Pine Creek population demographics are representative of the Northern Territory averages as seen in Table 23.

Table 23: Percent Distribution by Age Groups in Urban Areas

Age Group (years)	Pine Creek (%)	Total Northern Territory (%)
0 - 4	8.9	9.8
5 - 19	14.2	24.8
20 - 64	68.7	62.1
65 and over	8.2	3.2
Total	100	100

Facilities available in Pine Creek include:

- A community library and museum.
- Numerous sporting facilities, including indoor/outdoor sports centre.
- Multi-resource centre and community hall.
- A supermarket and two licensed premises.
- Three fuel outlets and a take-away food outlet.
- A police station.
- Health clinic with two permanent nurses and visiting doctor from Katherine once a week.
- Primary school including pre-primary.

Many facilities are available in Katherine (a regional centre), 90 kilometres away, or Darwin, 150 kilometres away.

7.5 VISUAL AMENITY

The project is in a sparsely populated area used primarily for pastoral activities. The main visible components of the project area are surface water dams, open pits, haul roads and the wetland formed on the old TSF. These are only visible from private roads within the project area and possibly from inaccessible hilltops within nearby pastoral leases.

The mining operations area will not be visible from any public road or railway. Mt Wells Road is eight kilometres away, Stuart Highway 20 kilometres away and Kakadu Highway 15 kilometres away.

The haul route and rail siding and rail loading stockpile area will be visible to the public. The railway embankment of the old spur line proposed as a haul route is visible from parts of the Mt Wells Road, but is not visually obtrusive. It is unlikely to be noticed by drivers not specifically looking for it. The proposed Roney Siding and rail loading stockpile area is visible from the Alice Springs-Darwin Railway, but not from public roads. It currently consists of an unremarkable flat area of open woodland in front of some small hills and the Union Reef gold operation. The Ghan passenger train carrying up to 550 passengers passes the area twice per week in each direction at about 85 kilometres per hour.

7.6 BITING INSECTS

Territory Iron commissioned the Medical Entomology Branch (MEB) of the Northern Territory Department of Health and Community Services to do a biting insect (mosquitoes and biting midges) assessment of the Frances Creek project area. A site inspection and initial adult biting insect trapping was conducted between 8 and 14 June 2006. A report summarising the findings of the field visit is attached as Appendix 11.

Actual and potential mosquito breeding sites recorded within or close to the project area are:

- Small dam next to the Helene 3 Pit.
- Tailings swamp and associated dams.
- Typha species reed habitat of the Helene 11 Pit.
- Upper reaches of the Frances Creek Main Dam.
- Frances Creek Upper Dam.
- Small dam between Helene 4 and Helene 5 Pits.
- Broad floodways near Ochre Hill (wet season only).

Many small ephemeral creeks of the project area are also likely to provide breeding habitat where vegetation grows in the water.

Density of larvae populations ranges from four larvae per 270 millilitres of water to one larvae per 270 millilitres of water. The main species present are *Culex palpalis*, *Anopheles annulipes s.l.* and *Anopheles bancroftii*.

The most common species of adult biting insects recorded from the Frances Creek project area are *Culex annulirostris* and *Anopheles annulipes s.l.* Several other species, including *Coquillettidia xanthogaster*, *Culex palpalis* and *Anopheles bancroftii*, also occur, but in very low numbers.

Culex annulirostris, *Culex palpalis*, *Anopheles annulipes s.l.*, *Anopheles bancroftii* and *Coquillettidia xanthogaster* have potential to become pest species given the right conditions for breeding. All bite after sundown though *Anopheles bancroftii* and *Coquillettidia xanthogaster* are known to bite during the day in shaded areas. It is also expected that *Ochlerotatus vigilax* and *Ochlerotatus normanensis* will be present though they were not recorded during the June site visit. Both species have been recorded in numbers likely to cause pest problems during trapping programs at the nearby Union Reef Gold Mine.

The nuisance status, possible vectors carried and peak abundance times for those species most likely to become pests are outlined in Table 24. Additional information on biting insect populations will be obtained during a 12 month adult biting insect trapping program which will conclude during 2007.

Table 24: Potential Pest Mosquitoes of the Frances Creek Project

Species	Nuisance Status	Potential Vectors	Peak Abundance
Anopheles annulipes s.l	+	Malaria	November - April
Anopheles bancroftii Black Malaria Mosquito	+++	Malaria	February – July
Coquillettidia xanthogaster The Golden Mosquito	+++	None known	March - August
Culex annulirostris Common Banded Mosquito	+++++	Murray Valley Encephalitis Virus Kunjin Virus Japanese Encephalitis Virus Ross River Virus Barmah Forest Virus	January - August
Culex palpalis Freshwater Banded Mosquito	+++	Murray Valley Encephalitis Virus Kunjin Virus Japanese Encephalitis Virus Ross River Virus Barmah Forest Virus	January - August
Ochlerotatus normanensis Floodwater Mosquito	+++++	Ross River Virus Barmah Forest Virus	September - January
Ochlerotatus vigilax Salt Marsh Mosquito	+++++	Ross River Virus Barmah Forest Virus	January - April

8. POTENTIAL IMPACTS AND MANAGEMENT

The following sub sections describe potential impacts that the Frances Creek project could have on the environment as well as proposed control measures and predicted impacts for each aspect.

8.1 LANDFORM AND SOILS

8.1.1 Potential Issues or Impacts

Soil management, especially topsoil overburden, is important to the success of rehabilitation. Potential issues identified are:

- Eroding rehabilitated surfaces particularly slopes of waste rock stockpiles and the consequent impacts on revegetation success.
- .
- Maintenance of suitable soil to allow successful revegetation of rehabilitated surfaces.
- Compacting soil surfaces by vehicles and mining equipment.
- Possible contamination of soils by hydrocarbons and other substances.

A site-specific environmental survey by Low Ecological Services identified that erosion potential is high during torrential summer rainfall. This is particularly so for skeletal soils on a steep terrain and areas with duplex soils when vegetation is removed (*Ridge Crests and Slopes* land unit). Historic mining activity has caused some gully erosion, especially where roads were built on unstable materials. Overall very little erosion is visible in previously-disturbed areas after 30 years despite minimal rehabilitation work.

In some areas, particularly on the steep slopes and crests of the Ridge Crests and Slopes land unit, it will not be possible to remove the topsoil prior to development. This is because the natural slopes are too steep for the safe operation of machinery. Topsoil in such areas is very shallow.

8.1.2 Management and Mitigation Measures

Territory Iron aims to conserve surface soil to help with long-term site rehabilitation and to minimise environmental degradation. Management and mitigation measures to achieve these aims include:

8.1.2.1 Topsoil Management

- Stripping topsoil to a depth of about 100 millimetres where practicable and placing directly onto rehabilitation areas or stockpiles. Completing direct replacement wherever practicable **(Commitment 8.1.2.1a)**.
- Placing stockpiled topsoil in windrows less than two metres high to minimise loss of seed viability and soil biota **(Commitment 8.1.2.1b)**.

- Progressive rehabilitation will be undertaken wherever practicable. All rehabilitation will be performed in accordance with contemporary accepted industry best practice and conducted in accordance with an approved MMP **(Commitment 8.1.2.1c)**.
- Stripping and stockpiling topsoil (where required) in dry and preferably still wind conditions, to minimise dust generation and assist rapid revegetation **(Commitment 8.1.2.1d)**.

8.1.2.2 Erosion

- Controlling slope gradients to minimise erosion and soil loss **(Commitment 8.1.2.2a)**.
- Installing diversion bunds and drains as necessary to control local surface water runoff to minimise overland flow and consequential erosion **(Commitment 8.1.2.2b)**.
- Ripping rehabilitation areas on the contour to remove compaction, improve soil structure and improve infiltration capacity **(Commitment 8.1.2.2c)**.
- Routinely inspecting rehabilitated and disturbed surfaces for erosion, particularly after significant rainfall. Implementing appropriate remediation measures if soil erosion is observed during routine inspections **(Commitment 8.1.2.2d)**.

8.1.2.3 Soil Contamination

Contamination management and mitigation measures are discussed in Section 8.10.2.

8.1.2.4 Rehabilitation

Rehabilitation management and mitigation measures are discussed in Section 10.

8.1.3 Impact Assessment

Potential adverse impacts on soil and landforms are expected to be minimal after implementing control measures described above.

Long-term change to the landscape will be minimal as a result of mining. All mining areas will be rehabilitated progressively before closure and some pits may be partially backfilled. Disturbed surfaces will be managed to prevent excessive erosion. Infrastructure areas will be rehabilitated to their pre-mining landforms and stabilised with local provenance flora species. Rehabilitation will be integrated into the mine plan and conducted as part of the mining operation.

Local provenance species will be used to rehabilitate disturbed areas. Revegetation will occur through careful management of topsoil and its contained seed resource. Supplementary seeding or planting may occur if rehabilitation monitoring demonstrates that revegetation is not proceeding in line with expected results.

Land uses occurring before the project may continue after appropriate protection of rehabilitation areas from grazing.

Identified Land Systems and land units are not endemic to the project area and are widely represented in the region. The vegetation, flora and fauna species of these land units is typical of the Wet-Dry Tropics. Land Systems, land units and their respective vegetation, flora and fauna have been reserved in nearby National Parks such as Kakadu National Park and Litchfield National Park.

8.2 WASTE ROCK MANAGEMENT

Waste products generated by the Frances Creek project will be predominantly inert waste rock. Eight waste rock stockpiles are present in the project area from previous mining. Due to differing environmental requirements at the time of mining, these stockpiles were not built in a manner conducive to rehabilitation. No physical rehabilitation works were done. Observations during recent site visits indicate that despite this:

- Thick vegetative growth has occurred on the Helene 2, 3, 4, 5 and 6/7, Thelma 1 and Jasmine waste rock stockpiles. This can be seen by comparing the aerial photographs from 1975 and 1999 in Figure 4 and Figure 5. Little vegetation has established on the Thelma 2 waste rock stockpile.
- All waste rock stockpiles are physically stable. Minor erosion (rilling) has occurred but is limited in nature and has not caused physical instability or significant contribution of sediments to nearby areas.

To minimise potential impacts of waste associated with construction, operation and decommissioning of the project, a range of mitigation commitments will be made in the Mining Management Plan.

8.2.1 Potential Issues and Impacts

Potential issues and impacts include:

- Acid development of soils.
- Lack of acid neutralising capacity.
- Contamination of surface water or groundwater leading to toxic environmental effects.
- Erosion of external surfaces over time. This may lead to loss of sediments to surface water drainages or in extreme cases instability of structures.

Geochemical characerisation studies demonstrated that traces of the chalcophile elements copper, lead, zinc and antimony plus arsenic, thallium and molybdenum will be largely concentrated in extremely carbonaceous footwall to the iron mineralisation. These are likely to be at very low levels in the hanging wall rocks. At the Thelma 2 Pit, previous mining has exposed a large amount of highly carbonaceous footwall material which is now below water level in the pit. This has resulted in chalcophile metals being leached and retained in solution in pit water. All sulphur in footwall waste rock has totally oxidised and current acidity in pit waters is dominated by organic acids from plant decomposition. The current values should be stable after 32 years and no further acidification is considered likely. Further mining at this site will increase the chalcophile element concentrations.

If total sulphur values in exposed siltstone waste rock in open pits exceed 0.1%S, backfilling of pits is requried to minimise contact between in-pit water and siltstone in final pit voids. In such a situation, it is then unlikely that chalcophile bearing sulphide minerals will be exposed to oxygenated water in water filled open pits after mine closure. Otherwise the water may acidify to values in the pH 3.2 to 4.9 range where aluminium hydroxy-sulphate acts as a pH buffer. Backfilling of pits where total sulphur values in exposed siltstone waste rock exceeds 0.1%S will prevent recurrence of the situation at Thelma Pit 2

8.2.2 Management and Mitigation Measures

All waste rock stockpiles will be progressively rehabilitated. Waste characterisation indicates no potentially acid forming rock is present in the proposed ore or waste rock. No rock types will require special handling.

Waste rock stockpiles developed next to each pit will be shaped so they form stable landforms. This will be achieved by:

- Progressively rehabilitating areas wherever practicable. All rehabilitation will be in accordance with contemporary accepted industry-best practice and in accordance with an approved MMP (**Commitment 8.1.2.1c)**.
- Designing waste rock stockpiles to a maximum height of 45 metres with gentle slopes (between 10 and 18 degrees) to facilitate controlled water shedding (**Commitment 8.2.2a)**.
- Contouring waste rock stockpiles so that they tie in with surrounding topography. The maximum height will not exceed 45 metres and will be less than or equal to the height of existing nearby ridges so that the final design is aesthetically pleasing **(Commitment 8.2.2b)**.
- Building diversion drains wherever stockpile construction obstructs significant water courses **(Commitment 8.2.2c)**.
- Deep ripping waste rock stockpiles on the contour to assist water absorption and minimise erosion **(Commitment 8.2.2d)**.
- Spreading waste rock stockpiles with local topsoil once shaping is complete to facilitate revegetation **(Commitment 8.2.2e)**. Local provenance speices will be used here additional seed is required. Territory Iron shall liase with pastoral station owners in relation to the suite of species to be used.
- Routinely inspecting rehabilitated waste rock stockpiles for erosion, particularly after significant rainfall. Implementing appropriate remediation measures if soil erosion is observed during routine inspections **(Commitment 8.1.2.2d)**.
- Waste rock will be used to backfill pits where total sulphur values in exposed siltstone waste rock in open pits exceed 0.1%S to minimise contact between in-pit water and siltstone in final pit voids **(Commitment 8.2.2f).**

Conceptual designs have been developed for each waste rock stockpile. These are shown in Appendix 3.

8.2.3 Impact Assessment

Waste characterisation results detailed in Section 6.2.1 indicate that no waste rock or ore in the project has any acid generation potential. Leachate testing of waste rock samples indicated that slight dilution and oxygenation will reduce concentration of leachates to below ANZECC 2000 trigger values to protect freshwater ecosystems.

Implementing the management and mitigation measures will result in stable vegetated landforms which have minimal impact on the environment. It will allow resumption of pre-mining low level grazing. Constructing and rehabilitating Helene 5 and Thelma Rosemary waste rock stockpiles will substantially improved rehabilitation of 8.1 hectares of Thelma 2 waste rock stockpile and 19.0 hectares of the former TSF and stockpile area.

8.3 GROUNDWATER

8.3.1 Potential Issues or Impacts

The proposed mining and processing operations pose the following issues:

- Lowering localised groundwater levels as a result of mine dewatering.
- Lowering localised groundwater levels as a result of abstracting water to use in crushing and screening operations and other ancillary uses.
- Discharge of water from mine dewatering causing localised recharge of groundwater.
- Deteriorating local groundwater quality as a result of seepage of contamination from mining activities into local aquifers after mining has ceased.

8.3.1.1 Dewatering

Existing pits are generally elevated in the local landscape. New pits will also be on rises. As part of hydrogeological investigations, AGT calculated the likely water table elevation for each pit. This was to determine whether interception of the water table was likely and whether dewatering would be required. Table 25 shows the estimated pit water-table levels calculated by AGT (AGT, 2006). From this it can be seen that other than the Helene 6/7 and Helene 5 Pits, the proposed pits will be predominantly at or above the water table. AGT consider it likely that dewatering from Helene 6/7 Pit would be sufficient to allow dry mining of the shallower Helene 5 Pit, which is located within 100 metres of the northern extent of Helene 6/7 (Figure 6). As no groundwater was encountered during exploratory drilling it is anticipated that no dewatering will be needed for other pits.

Table 25: Estimated Pit Water-table Levels

Pit	Proposed Pit Bottom EL (m AHD)	Valley EL (M AHD)	Estimated Water-table EL (m AHD)	Estimated Depth Below Water-table (m)	Comments
Helene 6/7	127.5	195	200*	72.5	* observed
Helene 5	180	200	205	25.0	Likely dry due

Pit	Proposed Pit Bottom EL (m AHD)	Valley EL (M AHD)	Estimated Water-table EL (m AHD)	Estimated Depth Below Water-table (m)	Comments
					to proximity of Helene 6/7
Jasmine East	200	180	185	-15.0	Likely dry pit
Thelma Rosemary	185	182	187	2.0	Almost dry pit
Ochre Hill	152.5	150	155	2.5	Almost dry pit

AGT also calculated likely drawdown for up to a 3,000 metre radius for each pit (Table 26). Review of these values indicates that drawdown impacts are likely to be localised and limited in extent. AGT also concluded that drawdown was likely to be reversible with full recovery of water levels within one wet season after pumping ceased.

Table 26: Anticipated Drawdown of Aquifers Surrounding Pits

Pit	Drawdown at Radial Distance (m) at Time of Six Months				
	Pit Face (0)	500	1,000	2,000	3,000
Helene 6/7	75	24.6	15.2	7.2	2.9
Helene 5	25	8.5	5.2	2.5	1.0
Thelma Rosemary	2	0.7	0.4	0.2	0.1

Modelling studies to determine impacts of dewatering are demonstrated by a conceptual model (AGT, 2006). The conceptual model demonstrates that essentially recharge over the pit areas drives local groundwater through-flow to lower elevations in the landscape, namely Frances Creek and numerous tributaries. Topography and lithology are key influences allowing water to move below ground. Figure 13 and Appendix C of the AGT Hydrogeology studies, (Appendix 5), details the 'localised' representation of a single groundwater flow cell of a pit, and its context in the local, intermediate and regional systems of groundwater flow.

Waste rock stockpiles will be developed next to each pit. In the short term, any seepage through the waste rock stockpiles will report to the pit because of the cone of depression that will be formed. In the longer term, little seepage through the stockpiles should occur as external surfaces are rehabilitated. Water will be used by plants established on the waste stockpiles or run off into adjacent drains.

All of the current or potential groundwater users in the Frances Creek area are believed to be beyond the range of any physical impacts likely to occur because of dewatering. AGT calculated that the likely range of impact would be four kilometres. Pastoral bores on Ban Ban Springs and Mary River West stations are beyond this distance from Frances Creek so their yields will not be affected.

8.3.1.2 Water Discharge

It is proposed to discharge groundwater abstracted from Helene 6/7 Pit to Helene 11 Dam with overflows potentially carrying on to Frances Creek Dam and Frances Creek during the wet season. The current Helene 6/7 Pit was dewatered in mid 2005 to allow exploration activities to occur. The pit was measured to make about 15 litres per second during this time.

If groundwater is encountered during mining of other pits, it will be collected in purpose built in-pit sumps. Preference will be given to using this water for ancillary uses within the pit i.e. dust suppression or drilling. If quantities greater than ancillary uses are encountered, it will be periodically pumped into trucks and discharged into Helene 11 Dam. Groundwater investigations do not indicate a need for more permanent abstraction infrastructure

Water discharge is discussed in more detail in Section 8.4.

8.3.1.3 Post Mining Water Balance

Abandoned pits which have been dewatered during mining will fill with groundwater (and stormwater during each wet season). Depending on regional groundwater flow regimes, potential exists for open pits to be groundwater sinks or recharge points. Based on measured water quality in existing pits, AGT concluded that:

- Low salinity of existing pits indicates that they are acting as collectors and groundwater recharge points during the wet season and evaporative discharges (groundwater sinks) during the dry season.
- Very little through flow is occurring. This is presumably because the local impact of pit lakes on groundwater flow is greater than that of topographically dependant hydraulic gradients. This can be expected to continue when new pits are developed.
- Contaminants residing in pit lakes are likely to remain there or to move only very short distances into surrounding fractured rock aquifers when driven by a recharge event. Subsequent evaporative discharge is likely to reverse this movement back towards the pit.

8.3.2 Management and Mitigation Measures

Management and mitigation measures to prevent or minimise adverse impacts on groundwater include:

- Regularly monitoring abstraction volumes and depth to water in production bores and monitoring bores during the life of the operation to enable Territory Iron to gain a better understanding of behaviour of underlying aquifer systems and the impacts of abstraction **(Commitment 8.3.2a)**.
- Installing groundwater monitoring bores in areas close to the Helene 11 Dam and Helene 5 and 6/7 pits to evaluate changing groundwater levels and allow early detection of any contaminated seepage from mining-related activities **(Commitment 8.3.2b)**.
- Monitoring quality of water collected in pit sumps before re-use for ancillary uses. Water will not be re-used if analytical results indicate it is of low pH **(Commitment 8.3.2c)**.

- Quarterly water quality monitoring of production bores and monitoring bores during the life of the operation to enable Territory Iron to determine effects of mining **(Commitment 8.3.2d)**.
- Conduct a formal aquifer review every two years using all monitoring data. Results will be provided to regulatory authorities and other interested stakeholders **(Commitment 8.3.2e)**.

8.3.3 Impact Assessment

Two pits are likely to intersect the watertable (Helen 6/7 and Helene 5) and will require dewatering to allow mining to safely occur. Local permeability of the fractured rock aquifer, the depth of penetration below the water table and the area of the pit floor (AGT, 2006) will govern dewatering rates.

Potential impacts of dewatering are those associated with localised drawdown of the water table around the pits and impacts arising from discharge of abstracted water. Theoretical estimates of pumping induced groundwater drawdown indicate that drawdown impact at Frances Creek is expected to be limited and totally reversible, with full recovery anticipated within one wet season after pumping stops (AGT, 2006).

The springs located in a tributary of Nellie Creek, approximately 10 kilometres east of the project area are believed to be sufficiently far from the mine site to be unaffected by any drawdown around pits or water supply bores (AGT, 2006).

The sole town water supply in the region is Pine Creek, 25 kilometres south of Frances Creek, outside the area of influence or impact. Pastoral bore yields for Ban Ban Springs and Mary River West stations will not be affected as they are outside the area of influence.

Abandoned pits, which have been dewatered during mining, will fill with groundwater (and stormwater during each wet season). Experience from historical mining operations at Frances Creek has demonstrated that pits which intersect the water table will act as groundwater recharge areas in the wet season and experience evaporative loss during the dry season. Location of the iron ore resources in topographic highs in the local area combined with the fractured rock nature of local aquifers means that little, if any, through flow of groundwater from the pits will occur. Any contaminants present in water in the pits will most likely be contained within the pits. If recharge fluxes from pit lakes are greater than evaporative losses, some leakage of soluble materials into local aquifers may occur in the short term. Impacts are likely to be low if contaminants are transported to areas where they may report to local surface waters because this is probable only in the wet season when a high level of dilution will occur.

8.4 SURFACE WATER

8.4.1 Potential Issues

Proposed mining and processing operations pose the following issues:

- Temporarily reducing surface water volume to water courses from diverting runoff from operational areas.

- Contaminating surface water from releasing contaminants associated with earthmoving, excavation, stockpiling and ore processing. Potential contaminants include sediment, turbidity, nitrate from explosives and hydrocarbons.
- Increasing water flow to existing dams and Frances Creek from releasing water from mine dewatering operations.
- Contaminating surface water runoff and soils from flow over stockpiles and areas where ore is spilt during loading of ore product from the siding stockpile into rail containers.
- Contaminating surface waters due to release of treated sewage effluent.
- Flooding of operational areas including the ore product haul road.

8.4.2 Runoff and Contaminant Management

Waste characterisation including leachate analysis testing (Section 5.4) indicates there is no potential for acid rock drainage from the proposed waste rock stockpiles and no special treatment of waste rock is required. Standard measures for control of runoff to reduce sediment load and turbidity will still be required. Potential for contamination of runoff is restricted largely to hydrocarbon storage and sewage effluent. The management and mitigation measures to be implemented include:

- Designing waste rock stockpiles to a maximum height of 45 metres with gentle slopes to facilitate controlled water shedding **(Commitment 8.4.2a)**.
- Constructing protection bunds and diversion channels to prevent flooding of pits, process areas, or other mine infrastructure **(Commitment 8.4.2b)**. The location of diversion structures is illustrated in Figure 13.
- Directing runoff from the stockpile and plant area to the Helene 11 Dam which will act as a settling pond and allow reuse of water **(Commitment 8.4.2c)**.
- Building out of pit waste rock stockpiles to prevent interference with natural surface water drainage or where this is not practicable to minimise impacts **(Commitment 8.4.2d)**.
- Directing surface water runoff from ore product stockpile areas at the rail siding through purpose-built drains to a sedimentation pond before discharge into existing railway drains **(Commitment 8.4.2e)**.
- Preventing sediment release to watercourses by installing sediment-control structures at discharge points where release of sediment is identified as a potential risk **(Commitment 8.4.2f)**.
- Installing culverts and/or floodways where mining haul roads and the ore product haul road cross watercourses **(Commitment 8.4.2g)**. Most roads, including the main haul road and the transport route to the rail siding, use existing culverts from previous operations. These consist of corrugated steel culverts with stone and mortar embankment protection and are generally in good condition. All culverts will be inspected and repairs carried out where necessary before operations begin. The new haul road to Ochre Hill will require two major and several minor watercourse crossings. Figure 13 shows likely locations where culverts and/or floodways will be installed.

- Wastewater in the form of sewage and grey water from workshop and office areas will be treated in approved waste water systems on or off site. No waste water will be discharged to any surface water for any purpose **(Commitment 8.4.2h)**.
- A sewage treatment system will be installed to service the office and workshop area in accordance with the requirements of the *Northern Territory Public Health Act* and Regulations including the Code of Practice for small onsite sewage and sullage treatment systems and the disposal or reuse of sewage effluent **(Commitment 8.4.2i)**. In view of the proximity of this site to watercourses, it will be necessary to either pump effluent to a more suitable site, install holding tanks and truck effluent to approved disposal systems in Pine Creek, or install an aerated or composting system.
- Hydrocarbons and other hazardous materials will be stored in appropriately designed self bunded tanks or bunded storage areas **(Commitment 8.4.2j)**.

8.4.3 Water Discharge

Discharge of water from open pits to watercourses, resulting in diluted discharge water leaving the mining tenements will occur in two areas. The major discharge will be from Helene 5 and 6/7 pits which extend below the groundwater table, requiring year round pumping of groundwater. A smaller discharge will be made of stormwater collected in Ochre Hill Pit. This will be discharged as required to a nearby creek during and immediately after storm events.

Water pumped from Helene 6/7 Pit was sampled and analysed during dewatering for exploration in April 2005. The water sampled was immediate inflow, not accumulated pit water, and is representative of expected discharge during mining operations. A summary of the results of analysis and comparison with local surface water is shown in Table 27. Full details of laboratory analysis are included in Appendix 4.

Table 27: Discharge Water Quality

Element	Units	Helene 6/7 Dewatering Sample	Range observed in Project Area Natural Surface Waters	Range observed in Mary River Catchment Study (Shultz et al, 2002)	ANZECC Default Trigger Value
pH	none	7.9	4.8-8.1	6.1 - 7.8	6.0-7.5
EC(2000)	µS/cm	106	25-596	12 - 342	20-250
NO3 Nitrogen	mg/L	<0.005	5-115	na	na
NH3 Nitrogen	mg/L	0.005	5-2,610	<0.01-0.02	na
Sulphate	mg/L	1.2	0.4-172	na	na
Turbidity	NTU	5	na	0.7 - 15.0	2 - 15
Aluminium	µg/L	**6,800**	**20-21,800**	<5-**260**	55
Arsenic	µg/L	1.05	0.4-7.7	<1-18	37

Cadmium	µg/L	<0.02	<0.02-0.16	<1-**3**	0.2
Cobalt	µg/L	0.1	0.04-45	<1-5.9	na
Chromium	µg/L	0.2	0.2-**1.6**	<1-<1	1
Copper	µg/L	1	0.78-**15**	<1-**12**	1.4
Iron	µg/L	60	80-4,150	44-1200	na
Magnesium	µg/L	9,200	300-35,500	460-17,000	-
Manganese	µg/L	11	0.68-870	3.8-390	1900
Molybdenum	µg/L	0.20	0.05-0.85	<1-15	na
Nickel	µg/L	1.77	<0.01-**50**	<1-**16**	11
Lead	µg/L	0.06	0.03-7	<1-<1	3.4
Selenium	µg/L	<0.2	<0.2-4.8	<1-<1	na
Uranium	µg/L	0.05	0.01-0.758	<1-1.3	na
Vanadium	µg/L	0.5	<0.01-**20**	<1-1.2	100
Zinc	µg/L	7	<0.05-**195**	<1-**200**	8

It can be seen from Table 27 that the water sourced from Helene 6/7 dewatering is of good quality. It is slightly alkaline with extremely low sulfate, so there are no acid drainage issues. The only substance exceeding ANZECC default trigger values for protection of aquatic ecosystems is aluminium, which is relatively high at 6,800 micrograms per litre. Although well above guidelines it is within the range of values observed in surface water sampling in the project area, the highest observed value in the project area is the Helene 9 dam which receives runoff from an undisturbed catchment, and has four times more aluminium than the Helene 6/7 dewatering discharge.

Stormwater pumped from Ochre Hill Pit is expected to meet discharge criteria as it is rainwater with only brief exposure to fresh rock in the pit, and ore and waste analysis indicates no problems due to exposure of water to these materials are likely.

The following management and mitigation measures will be undertaken to minimise the impact of discharge of water:

- A water release management plan will be developed for the disposal of excess mine water **(Commitment 8.4.3a)**. As described in Section 4.6.2, excess water will need to be discharged prior to mining below the water table. This plan will include monitoring requirements.
- A water discharge licence will be obtained from NRETA to permit release of water from Frances Creek Dam to Frances Creek, and from pit stormwater sumps to Maude Creek tributaries. All water releases to the environment will meet approved water quality criteria as defined in the discharge licence **(Commitment 8.4.3b)**.
- In pit sumps will be built to contain stormwater and allow re-use for in pit dust suppression. All water discharged from pits to watercourses will be passed through sedimentation basins **(Commitment 8.4.3c)**.

8.4.4 Extreme Rainfall Events

The proposed mining operation is intended to operate year-round, but Territory Iron considers delays of up to a couple of days due to extreme rainfall acceptable. All infrastructure, except some small sections of roads, has been designed so that it is located on high ground above projected 100-year Average Recurrence Interval (ARI) flood levels. Road crossings will be designed to survive extreme rainfall events while allowing natural flows to pass, but may become temporarily unusable for traffic while water levels are high.

Extreme rainfall events are likely to cause overtopping of all water storage dams on Frances Creek. The water stored in these facilities is of suitable quality for release to the environment, and a discharge licence will be acquired to allow these facilities to discharge via their spillways during high rainfall events.

To prevent potential overflow of pit lakes in Jasmine Central and Thelma 2 Pits, stormwater will only be pumped to these pits as long as there is sufficient freeboard in the pits to contain runoff from a 1 in 100-year average recurrence interval, 72 hour duration rainfall event **(Commitment 8.4.4a)**.

All dam spillways will be inspected before each wet season, and after each discharge event and repairs carried out if necessary **(Commitment 8.4.4b)**.

8.4.5 Catchment Monitoring

A water monitoring program will be implemented under the Environmental Management Plan (Appendix 12) **(Commitment 8.4.5a)**. The monitoring program will record water quality upstream and downstream of operations, and will include monitoring sites downstream of all operational activities. Data from DPIFM monitoring sites located in the wider Mary River catchment will also be reviewed.

The water monitoring program will include regular sampling of water upstream and downstream of all mining activities within the tenements and stockpiling at Roney Siding. Monitoring results will be reviewed regularly against past monitoring and ANZECC guidelines to detect any deterioration in water quality and allow action to be taken **(Commitment 8.4.5b)**. Monitoring results will be reported to NRETA in annual environmental reporting.

The water monitoring program will include analysis of water potentially to be discharged to the environment prior to any such discharge **(Commitment 8.4.5c)**.

8.4.6 Impact Assessment

Waste and ore characterisation indicates there will be no problems with water quality from ore and waste rock stockpiles. These findings are confirmed by the successful revegetation of old waste rock stockpiles and TSF from previous operations.

Implementing management and mitigation measures described above will ensure that potential for contamination of surface water is minimised, catchments containing potentially

contaminated surface water flows are appropriately managed before release and disruption to natural flow regimes is minimised.

Excess mine dewatering water will only leave the operation area after considerable dilution in Helene 11 and Main Frances Creek Dam. The quality of discharge water is very similar to the receiving waters and is not expected to have any adverse impact on water quality. The effect will be only of a slight increase in salinity during flood flows.

8.5 VEGETATION AND FLORA

8.5.1 Potential Issues or Impacts

Redeveloping historical pits and establishing new pits, infrastructure and roads may result in a number of potential impacts on vegetation and flora of the Frances Creek project area including:

- Clearing approximately 172 hectares of native vegetation (see Table 28). Of this, 78 hectares is located in areas of historical disturbance that are considered to be in a degraded condition. Development of new pits and infrastructure will result in approximately 94 hectares of previously undisturbed vegetation being cleared. The Thelma Rosemary waste rock stockpile will require small amounts of creek line (Riparian) vegetation to be cleared. Construction of the Helene 5 waste rock stockpile will require approximately 5.5 hectares of the swamp created by the old tailings storage facility to be cleared.
- Introducing or spreading weed species.
- Changes in creek line vegetation due to dewatering discharges.

Potential issues and impacts on native vegetation and flora are discussed in detail below.

It is anticipated that land clearing of the Jasmine East area will occur in early 2007. All other land clearing will be during 2006. Jasmine East area will require a total of nine hectares of the Redge Crests and Slopes to be cleared.

An isolated patch of Cycads (*Cycas armstrongii*) which is categorised as Vulnerable under the *TPWC Act 2000*, is located near the Ochre Hill Road. This population could potentially be disturbed during road-widening activities.

Introducing and spreading weeds through the Frances Creek project area has potential to alter vegetation composition and structure and alter erosional potential of landforms or soils. It could also create increased fire hazards, particularly with weed species that result in large masses of dry vegetative material. Weeds may be spread or introduced through the following means:

- Transporting vegetative material in soil and/or mud on vehicles (e.g. in tyre tread or underneath of body).
- Human transport of vegetative material in soil and/or mud (e.g. on soles of boots).
- Transporting ‘sticky’ or ‘hairy’ seeds on clothing.

As outlined in Section 4.6, mining operations will require dewatering of the Helene 6/7 Pit. before recycling the water will be directed to and stored in Helene 11 Dam near the TSF Due to natural surface runoff and dewatering inflows, Helene 11 Dam will overflow during the wet season in average rainfall years. It is estimated that approximately 880 megalitres of water will be discharged from the Helene 11 Dam during an average wet season, compared with pre-mining flow patterns of 550 megalitres. Overflow from Helene 11 Dam will flow into the Frances Creek Main Dam.

The overflow will begin slightly earlier and continue slightly longer than in the pre-mining situation. Availability of excess water from the overflow of Helene 11 Dam during the wet season may lead to changes in vegetation density and structure in the area between the Helene 11 Dam and Frances Creek Main Dam, but the variation will be comparable to normal seasonal variations.

Table 28: Land Clearing Requirements

Name	Total Area (ha)	Total Area Previously Disturbed (ha)	Total Area Previously Undisturbed (ha)	Area Previously Undisturbed (ha)				Area Previously Disturbed (ha)				
				Ridge Crests and Slopes	Low Hills	Small Alluvial Flats	Riparian	Ridge Crests and Slopes	Low Hills	Small Alluvial Flats	Riparian	Low Undulating Hills
Plant, Magazine & Offices	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.60	0.40	0.00	0.00	0.00
Pits	38.50	19.00	19.50	15.50	4.00	0.00	0.00	17.00	2.00	0.00	0.00	0.00
Waste Rock Stockpiles	91.50	32.50	59.00	30.00	27.50	1.00	0.50[1]	17.00	10.50	0.00	5.50[2]	0.00
Product Stockpiles	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
ROM Stockpile	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
Hardstand for Stockpiles & Plant	2.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00
Workshops, Fuel Store & Wash down Bay	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00
Roads	23.50	12.50	11.00	0.50	5.00	5.50	0.00	1.00	11.00	0.50	0.00	0.00
Haul Road to Railway Siding & Intersection Improvements	11.00	8.50	2.50	0.00	2.00	0.50	0.00	0.00	3.00	1.50	0.00	4.00
Railway Siding and Stockpile	2.00	0.00	2.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Totals	172.00	78.00	94.00	46.00	40.50	7.00	0.50	35.60	30.90	2.00	5.50	4.00

[1] Estimate only as the width of riparian vegetation along creek lines varies considerably. This clearing estimate is based on a vegetation width of seven metres.

[2] Estimated area of the swamp created by the old tailings storage facility.

8.5.2 Management and Mitigation Measures

Territory Iron aims to minimise loss of habitat and vegetation and re-establish appropriate vegetation communities and habitat through rehabilitation. Territory Iron will endeavour to manage and control the spread of weed species as a result of its operations. Management and mitigation measures to achieve these aims include:

8.5.2.1 Vegetation Clearing

- Developing a Vegetation Clearing Management Procedure as part of the EMP (**Commitment 8.5.2.1a)**.
- Obtaining necessary licences and permits to clear land associated with the Frances Creek project area (**Commitment 8.5.2.1b)**.
- Minimising the impact of clearing by restricting vegetation clearing to the minimum necessary for operations (**Commitment 8.5.2.1c)**.
- Wherever possible locating operations on areas already disturbed by previous mining (**Commitment 8.5.2.1d)**.
- Clearly delineating the perimeter boundary of all areas approved for clearing before clearing works begin (**Commitment 8.5.2.1e)**.
- Clearly marking the patch of cycads near the Ochre Hill road so they are not disturbed during road-widening activities (**Commitment 8.5.2.1f)**.

8.5.2.2 Weed Management

- Preparing a Weed Management Plan as part of the EMP. The plan will include, but will not be limited to, issues of vehicle and personal hygiene in regards to weeds, identification of weed species (including noxious weeds) and control and eradication measures **(Commitment 8.5.2.2a)**.
- Confining company vehicles to travelling on purpose-built roads to minimise potential vehicle-borne spread of weed species **(Commitment 8.5.2.2b)**.

8.5.2.3 Rehabilitation

Rehabilitation management and mitigation measures are discussed in Section 10.

8.5.3 Impact Assessment

This section assesses the impacts outlined in Section 8.5.1 and provides a risk ranking for each impact taking into account management actions outlined in Section 8.5.2. The risk ranking is based on Australian Standard AS/NZ 4360 *Risk Management* and uses the risk matrix shown in Chart 4 and definitions outlined in Table 29.

Chart 4: Risk Matrix

LIKELIHOOD	CONSEQUENCES				
	5 Catastrophic	4 Major	3 Severe	2 Minor	1 Negligible
A Almost Certain	Extreme (128)	Very High (64)	High (32)	Moderate (16)	Moderate (8)
B Likely	Very High (64)	High (32)	Moderate (16)	Moderate (8)	Low (4)
C Moderate	High (32)	Moderate (16)	Moderate (8)	Low (4)	Negligible (2)
D Unlikely	Moderate (16)	Moderate (8)	Low (4)	Low (2)	Negligible (1)
E Rare	Moderate (8)	Low (4)	Negligible (2)	Negligible (1)	Negligible (0)

Table 29: Risk Likelihood and Consequence Definitions

Likelihood (How likely is the event to occur)		Consequence (Significance of associated environmental impact)	
Rating	**Definition**	**Rating**	**Definition**
A Almost Certain	The event is expected to occur in most circumstances	**5 Catastrophic**	Disaster with potential to lead to collapse
B Likely	The event probably will occur in most circumstances (e.g. weekly to monthly).	**4 Major**	Critical event, which with proper management , will be endured
C Moderate	The event should occur at some time i.e. once in a while.	**3 Severe**	Significant event, which can be managed under normal procedures
D Unlikely	The event could occur at some time	**2 Minor**	Consequences can be readily absorbed but management effort is still required to minimise impacts
E Rarely	The event may occur only in exceptional circumstances.	**1 Negligible**	Not worth worrying about

8.5.3.1 Vegetation Clearing

Local surface disturbance will remove vegetation in the immediate project area. Overall the impact will be minimal with loss of regionally insignificant vegetation communities (Reilly et al, 2006). Rehabilitation of disturbed areas will occur as vegetation is progressively re-established and as the site is decommissioned when mining stops.

Risk Rating

The likelihood of occurrence is A – Almost Certain. The consequence is 2 – Minor. This gives a risk rating of 16 – Moderate.

8.5.3.2 Cycad Population

Though the vegetation and flora of the project area is common both locally and regionally, one population of Cycads (*Cycas armstrongii*) was recorded near the Ochre Hill Road. The population is located approximately 50 metres from the edge of the road. It is unlikely that road widening and improvement will impact on these plants.

Risk Rating
The likelihood of occurrence is D – Unlikely. The consequence is 3 – Severe. This gives a risk rating of 4 – Low.

8.5.3.3 Weeds

A number of weed species are already present, particularly in areas subject to historical mining activities. It is likely that without proper management weeds will spread into areas of new disturbance. It is moderately likely that new weed species will be introduced to the project area when vehicles and equipment are brought to site. Reilly et al. (2005, 2006) suggest that most weed species in question are confined to areas of disturbance and thus weed spread is likely to be slow. Implementing a Weed Management Plan will be sufficient to minimise the impacts of weed spread and/or introduction.

Risk Rating
The likelihood of occurrence is B – Likely. The consequence is 2 – Minor to 3 – Severe. This gives a risk rating of 8 to 16 – Moderate.

8.5.3.4 Dewatering Discharge

Dewatering during the life of the mine will increase flows from Helene 11 Dam to the Frances Creek Main Dam by a factor of approximately 1.85. Discharge from the decant dam will only occur during the wet season and pre-mining flows will re-establish once mining stops. Any changes to vegetation density and structure will be temporary. Any spread of weeds within this area will be managed by implementing a Weed Management Plan.

Risk Rating
The likelihood of occurrence is C – Moderate. The consequence is 1 – Negligible to 2 – Minor. This gives a risk rating of 2 – Negligible to 4 – Low.

8.6 FAUNA

8.6.1 Potential Issues or Impacts

Developing and operating the Frances Creek Project poses the following issues:

- Removing 185.35 hectares of habitat during the life of the mine, of which 61.32 hectares (33%) has been previously disturbed.
- Disturbing the Freshwater Crocodiles residing in pit waters of Helene 4.
- Removing part of the Tailings Swamp habitat for waterbirds due to construction of the Helene 5 Waste Rock Stockpile.

- Placing waste rock stockpiles across minor creeks and over the Tailings Swamp will remove habitat available for aquatic animals.
- Removing Ghost Bat roost site through destruction of the historical conveyor tunnel.
- Adversly impacting species of conservation significance such as the Orange Horseshoe Bat, Arnhem Sheathtail Bat, Partridge Pigeon, Pale field-rat, Western Chestnut mouse and Calaby's Pebble-mound mouse.
- Accidentally killing animals on mine roads and the haul road to the Alice Springs–Darwin Railway.
- Controlling feral animals such as donkeys, horses, cats and pigs.
- Developing breeding habitat for biting insects

8.6.2 Management and Mitigation Measures

Territory Iron aims to minimise loss of fauna habitat and re-establish appropriate habitat through rehabilitation.

Management and mitigation measures to achieve these aims include:

- Requiring employees and contractors to attend an induction program that will include a component on environmental management. In particular, the induction will clearly explain employee and contractors' roles and responsibilities to restrict impacts on fauna and habitat **(Commitment 8.6.2a)**.
- Educating all employees and contractors to recognise species of conservation significance, particularly the Gouldian Finch, and requiring them to report any sightings to the Environmental Manager **(Commitment 8.6.2b)**.
- Reporting sightings of species of conservation significance to the Northern Territory Parks and Wildlife Commission **(Commitment 8.6.2c)**.
- Liaising, with the Northern Territory Parks and Wildlife Commission to ensure that appropriate relocation measures are used to relocate Freshwater Crocodiles, when required **(Commitment 8.6.2d)**.
- Developing a Gouldian Finch monitoring program and Management Plan in consultation with relevant consultants and the Northern Territory Parks and Wildlife Commission **(Commitment 8.6.2e)**.
- Disturbing roosting Ghost Bats in the old conveyor tunnel at dusk two or three days before destroying the tunnel and checking to ensure no bats remain **(Commitment 8.6.2f)**.
- Investigating, in consultation with relevant experts, the possibility of constructing an alternative roost site for Ghost Bats either during mining operations or when mining stops **(Commitment 8.6.2g)**.
- Restricting speeds on haulage routes and mine roads to minimise fauna death on roads **(Commitment 8.6.2h)**.
- Developing a Wildlife Rescue Procedure to operate in conjunction with land-clearing operations and where vehicle movements occur between dusk and dawn **(Commitment 8.6.2i)**.
- Participating in feral animal control programs on Ban Ban Springs and Mary River West stations, if requested by owners **(Commitment 8.6.2j)**.

- Banning domestic animals and firearms on site **(Commitment 8.6.2k)**.
- Building sections of waste rock stockpiles that impact on creek lines or the Tailings Swamp during the dry season **(Commitment 8.6.2l)**.

Management and mitigation measures for biting insects are outlined in Section 8.15.2.

8.6.3 Impact Assessment

8.6.3.1 Habitat Removal

Most land clearing will occur in the ridge crests and slopes land unit. Results of the November 2005 and May 2006 surveys show that this habitat contains the lowest diversity and density of fauna species. Those terrestrial species that inhabit the low hills and small alluvial flats are highly mobile and unlikely to be affected by localised clearing needed for the Frances Creek project. Additionally, very few trees of an age and/or size to provide hollows for fauna will be removed during project development.

Risk Rating
The likelihood of occurrence is A – Almost Certain. The consequence is 1 – Negligible. This gives a risk rating of 8 – Moderate.

8.6.3.2 Ghost Bat Colony

Ghost bats tend to move between a number of roosts seasonally or as dictated by weather conditions (Chiroptera Specialist Group, 1996) with sites likely to be located within 10 to 20 kilometres (Reilly et al, 2006). It is unlikely that the old conveyor tunnel would be the only roost site for the colony in the region. Management actions outlined above, together with the possible construction of an artificial roost nearby, will ensure that any impacts upon the Ghost Bats are minimal.

Risk Rating
The likelihood of occurrence is A – Almost Certain. The consequence is 2 – Minor. This gives a risk rating of 16 – Moderate.

8.6.3.3 Freshwater Crocodiles

The Freshwater Crocodiles residing in Helene 4 Pit will only need to be relocated if they pose a risk to mine workers' safety. If relocation is required, the management actions outlined above will ensure there are no adverse impacts on the crocodiles.

Risk Rating
The likelihood of occurrence is E – Rare. The consequence is 1 – Negligible. This gives a risk rating of 0 – Negligible.

8.6.3.4 Waterbirds

Building the Helene 5 waste rock stockpile will ultimately cover much of the swamp that has developed at the old TSF. However, it is expected that any waterbirds utilising this site will moved to either the Frances Creek Main Dam or the Frances Creek Upper Dam. An area of wetland, including the small dams, is likely to remain to allow drainage around the base of the

waste rock stockpile. Once the waste rock stockpile is complete, waterbirds will be able to return to this area.

Risk Rating
The likelihood of occurrence is A – Likely. The consequence is 2 – Minor. This gives a risk rating of 8 – Moderate.

8.6.3.5 Aquatic Habitat

The areas of creek to be impacted by construction of the Thelma Rosemary and Jasmine East waste rock stockpiles only flow during the wet season. They do not retain any pools of water during other times of the year. Building these sections of waste rock stockpiles during the dry season will ensure no adverse impacts on aquatic fauna.

Although most of the Tailings Swamp will be covered during construction of the Helene 5 Waste Rock Stockpile, the western portion, including the small dams, will remain. So construction of the Helene 5 Waste Rock Stockpile will not impact on fish species and aquatic invertebrates identified during the May 2006 survey (Reilly et al, 2006) as these species were restricted to the small dams. Other species such as frogs and reptiles will suffer a small reduction in habitat, however these species may move to the remaining portion of the wetland or to other areas such as the Frances Creek Upper Dam or the Frances Creek Main Dam.

Risk Rating
The likelihood of occurrence is B – Likely. The consequence is 2 – Minor. This gives a risk rating of 8 – Moderate.

8.6.3.6 Fauna Deaths on Haul Roads

With regular movement of vehicles along roads both within the mine and between the mine and the railway siding, it is probable that some animal injuries and death will occur. Restricting the speed at which vehicles can travel will reduce the likelihood of vehicle-animal collisions. It will also reduce the severity of potential injuries, particularly to larger animals. Implementing a Wildlife Rescue Procedure will ensure that any injured animals are treated humanely.

Risk Rating
The likelihood of occurrence is C – Moderate. The consequence is 2 – Minor. This gives a risk rating of 4 – Low.

8.7 AIR RESOURCES MANAGEMENT

8.7.1 Potential Issues or Impacts

Air emissions will result primarily from burning fuels for generator sets, plant, earthmoving equipment and mine vehicles on site. Gaseous emissions will also be generated from vehicles transporting iron ore product to the railway siding and vehicles delivering supplies to site. Dust generation will occur from mining operations.

Potential air quality issues include:

- Generating dust from stripping and replacing topsoil and overburden, excavating ore and vehicle movement on unsealed roads.
- Generating dust during transport of product from the mine site to the railway siding. The ore is classified as non-toxic, (material safety data sheet attached as Appendix 13), so product dust issues are equivalent to general dust issues.
- Wind erosion of product during stockpiling at the siding.
- Generating dust while loading product for transport.
- Gaseous emissions from engine exhausts of earthmoving equipment and mine vehicles. This includes carbon monoxide, carbon dioxide and nitrous oxides. This is discussed in more detail in Section 9.7.1.1.

8.7.1.1 Greenhouse Gases

An estimated 4,300,000 litres per annum of fuel is expected to be burnt at the site.

Greenhouse gas emissions at the Frances Creek mine site will only be produced by diesel consumption and production of landfill waste.

Using the emissions calculator provided by the Australian Green House Office (http://www.greenhouse.gov.au/challenge/members/technicaltools.html), the emissions outlined in Table 30 were determined.

Table 30: Predicted Emissions of Greenhouse Gases

Process/Fuel	Consumption	Emissions (Tonnes CO_2-equivalent)	
		Per Annum	Total
Automotive Diesel Oil	4,300 kL	11,610	34,830
Co-mingled Waste (Landfill)	1 tonne	1.2	3.6
Totals		**11,611.2**	**34,833.6**

Emissions from landfill are typically considered to consist of 45% carbon dioxide and 55% methane. Methane is considered to have 21 times the greenhouse effect of carbon dioxide. Therefore, emissions of methane from landfill are estimated to be 31.4 kilograms per year and 94.2 kilograms for the life of the mine.

The Australian Greenhouse Office (2005) states that "broadscale clearing of remnant vegetation is generally assumed to produce emissions of one megatonne carbon dioxide-equivalent from clearing of 4,000 hectares". As the area of new clearing for the Frances Creek project is about 94 hectares, the total emissions from clearing are estimated to be 24,000 tonnes of carbon dioxide-equivalent over the life of the mine. This will be balanced by carbon uptake occurring during revegetation.

8.7.2 Management and Mitigation Measures

Territory Iron will aim to minimise air emissions likely to impact air resources. The following sections detail management and mitigation measures to ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses.

8.7.2.1 Point Sources

The primary point sources have been identified as:

- Generating dust during crushing and screening operations.
- Chemical and hydrocarbon storage.
- Principle electrical generation facilities.

To minimise point source emissions Territory Iron will aim to minimise and control air emissions that are likely to affect local air quality. The following management and mitigation measures to achieve this aim are:

- Installing high pressure, low volume sprays at the crusher, on conveyors and over stockpiles for dust suppression and procedures applied in line with industry practice **(Commitment 8.7.2.1a)**.
- Maintaining and operating pollution control devices, such as extractors, conveyor covers and sprinklers installed at point sources in good working order **(Commitment 8.7.2.1b)**.
- Regularly maintaining generators and stationary plant to manufacturers' specifications to minimise exhaust emissions **(Commitment 8.7.2.1c)**.
- Reporting emissions as part of the National Pollutant Inventory **(Commitment 8.7.2.1d)**.
- Taking all practicable measures to minimise energy consumption **(Commitment 8.7.2.1e)**.

8.7.2.2 Fugitive Sources

The primary fugitive sources have been identified as:

- Road construction.
- On-site light vehicle traffic.
- Other earthwork and constructive activities.
- Other large non-vegetated areas (such as parking and material storage areas).
- Mobile equipment emissions from engine exhausts. This includes carbon monoxide, carbon dioxide and nitrous oxides.
- Generation of dust from stripping and replacing topsoil, excavating ore and vehicle movement on unsealed roads.
- Generating dust during transfer operations. These include loader to truck or conveyor transfer points.

Management and mitigation measures to minimise fugitive source emissions:

- Requiring vehicles travelling on unsealed roads to travel at speeds that will not generate excessive dust **(Commitment 8.7.2.2a)**.
- Applying water to unsealed roads, especially haul roads, to minimise dust emissions. Modifying the volume and frequency of water applied to control dust emissions in different climatic conditions **(Commitment 8.7.2.2b)**.
- Limiting movement of mobile equipment and vehicles to clearly marked routes or areas where dust control methods can be used **(Commitment 8.7.2.2c)**.

- Employees and contractors will participate in site inductions to ensure they are aware of site rules for permanent and temporary roads **(Commitment 8.7.2.2d)**.
- Banning vehicle access on rehabilitated surfaces except for management purposes **(Commitment 8.7.2.2e)**.
- Rehabilitating and revegetating completed areas as soon as practicable **(Commitment 8.7.2.2f)**.
- Progressively rehabilitating areas to minimise exposure to wind erosion. Vegetation established will be compatible with the post-mining land use of the area **(Commitment 8.7.2.2g)**.
- Placing soil material stripped from the product ore stockpile area in a windrow at the edge of the stockpile area. Forming the stockpile to reduce ground surface winds and minimise wind erosion **(Commitment 8.7.2.2h)**.

8.7.2.3 Greenhouse Gases

Management and mitigation measures to minimise greenhouse gas emissions:

- Joining the Federal Government's Greenhouse Challenge program and monitoring greenhouse emissions and efficiency **(Commitment 8.7.2.3a)**.
- Energy efficiency will be a major consideration in the selection and design of equipment and plant **(Commitment 8.7.2.3b)**.
- Encouraging all employees to be energy efficient in their day to day activities and educating them on this **(Commitment 8.7.2.3c)**.
- Progressively rehabilitating areas where practicable **(Commitment 8.2.2c)**. This will increase the amount of greenhouse gases removed from the atmosphere and stored in vegetative matter.

8.7.3 Impact Assessment

The nearest residence to the project is eight kilometres away at Union Extended Mine and the nearest settlement is 23 kilometres away at Pine Creek. The remote location of the project and absence of nearby residential facilities limits potential adverse impacts air emissions are expected to have on the local or regional environment and/or human health. Dust emissions will be localised.

Fugitive dust will be generated from mining and blasting activities, vehicular movement and wind erosion. Dust generated will be localised. Experience with other mining operations has demonstrated that these relatively course particles (i.e. greater than 10 microns) are highly likely to settle within a short distance of the point of generation.

Greenhouse gas emissions will result primarily from on-site generation of power and from exhausts of vehicles and mobile equipment. Given the project's remoteness, it is not anticipated that the additional greenhouse gas resulting from this project will have an adverse impact on local or regional air quality. Territory Iron aims to minimise as far as practical the production of greenhouse gases to minimise the impact on global air quality and climate variability.

8.8 NOISE AND VIBRATION MANAGEMENT

8.8.1 Potential Issues or Impacts

Noise generated as a result of the project will be primarily due to:

- Mobile equipment noise and vibration emissions from engines.
- Processing and generator noise and vibration emissions from exhausts and plant operations.
- Blasting in open pits.
- Transport of iron ore to the railway siding.

8.8.2 Management and Mitigation Measures

To minimise noise and vibration emissions Territory Iron will use engineered controls where practicable. This will include the following measures:

- Equipment generated noise will be reduced by installing soundproofing and/or noise abatement devices around/on primary sources of noise such as power generators and water pumps **(Commitment 8.8.2a)**.
- Vibration generated by equipment will be reduced by installing shock-absorbing devices or materials around the primary sources of vibration such as the ore processing equipment and water pumps **(Commitment 8.8.2b)**.
- The natural acoustic barriers (for example trees and ridges) between noise sources and neighbouring communities will be maintained as far as practicable **(Commitment 8.8.2c)**.
- Hearing protection equipment will be made available and utilised in onsite areas where engineering controls are deemed inappropriate or ineffective **(Commitment 8.8.2d)**.

All of the mining and processing operations at Frances Creek will comply with the National Standard for Occupational Noise [NOHSC: 1007(2000)]. Periodic noise surveys evaluate and ensure compliance with noise regulations and identify where noise controls need to be improved.

8.8.3 Impact Assessment

As with air quality, impacts of noise and vibration emissions from the project are not anticipated to be significant due to the remote location and distance from the nearest residence (over eight kilometres away). Controls and barriers implemented to meet DPIFM requirements to protect the occupational safety of employees will ensure impact on the nearest residence will not be significant.

8.9 RADIOACTIVITY

8.9.1 Potential Issues or Impacts

The presence of detectable levels of uranium and thorium in ore and waste rock raises potential issues and impacts relating to radioactivity. These include:

- Exposure of workers to radon gas and dust.
- Exposure of workers to background radiation.

A background gamma radiation and radon survey of the project area was carried out by Western Radiation Services between 18 and 23 May 2006 (Appendix 9). This indicated that the background gamma radiation exposure rate is at or below normal background levels for the world, although above the natural background level for Australia. All estimates of radiation exposure for workers indicate that the exposure without preventative measures will be within recommenced limits for exposure of members of the public (see Section 6.10). Industry best practice is to achieve radiation exposure levels as low as reasonable possible, and Territory Iron will implement management and mitigation measures with this aim.

8.9.2 Management and Mitigation Measures

Management and mitigation measures to prevent or minimise adverse impacts of radiation will include:

- Stockpiling ore in open areas to prevent possible build up of radon gas **(Commitment 8.9.2a)**.
- Mine personnel will be accommodated in Pine Creek, well away from the mineralised areas of the mine site **(Commitment 8.9.2b)**.
- Ore will be blended at the crushing stage to keep overall uranium concentration well below levels of concern **(Commitment 8.9.2c)**.
- Trialling personal dust monitors in initial mining of higher uranium areas to confirm exposure to uranium through dust is minimal **(Commitment 8.9.2d)**.
- Installing passive radon monitors to measure radon gas exposure over a three month period **(Commitment 8.9.2e)**.
- Potential radiation exposure of workers will be reviewed whenever additional monitoring data becomes available **(Commitment 8.9.2f)**.
- Workers will be required to follow a strict hygiene policy, in particular they must wash their hands before eating, drinking or smoking **(Commitment 8.9.2g)**.
- Access to the project site will be limited to employees and authorised visitors. All project access will be well signposted to control traffic movement in and out of the project area **(Commitment 8.9.2h)**.
- Normal dust control measures will be applied (Section 8.7.2).

8.9.3 Impact Assessment

Implementation of the management and mitigation measures will result in levels of radiation exposure to workers well within industry standards for members of the public and probably within the range of normal world background levels. Ongoing monitoring is expected to confirm radiation exposure remains within acceptable levels.

Public access will not be permitted to mine and stockpile areas, so the only public exposure to material of above average radioactivity will be distant and brief exposure to product in transit, resulting in exposure orders of magnitude lower than the acceptable level of exposure to employees.

8.10 WASTE AND HAZARDOUS MATERIALS

8.10.1 Potential Issues or Impacts

Project operations pose the following potential hazardous materials issues:

- Spillage to the environment of hydrocarbons and hazardous materials used in the mining or associated activities.
- Incorrect storage of hazardous materials leading to contamination of soil, surface water and ground water.
- Disposal of hazardous wastes generated during construction and operations including tyres, waste oil, grease and industrial waste.
- Spillage of ore product during transport to the railway siding.
- Disposal of putrescible wastes in an onsite landfill.
- Storage of explosives.

8.10.2 Management and Mitigation Measures

Territory Iron will aim to effectively manage hazardous materials so as to minimise and control any potential discharges to the environment.

Management and mitigation measures to achieve this aim will include:

8.10.2.1 Materials

- Managing hazardous and non-hazardous material in accordance with statutory regulations, standard industry structures and procedures. Adopting strict procedures to ensure adequate records of delivery and use are maintained to ensure earliest possible detection of losses and to avoid site contamination **(Commitment 8.10.2.1a)**.
- Developing and maintaining a register of all hazardous materials imported to the site or generated as a result of activities undertaken at the site. This will document the hazardous material name, location, approximate volume, storage method and, where applicable, disposal method for the substance and containers **(Commitment 8.10.2.1b)**.
- Maintaining an inventory of hydrocarbon use to easily determine whether storage containers are leaking **(Commitment 8.10.2.1c)**.
- Bringing hazardous materials to the site in bulk packaging wherever possible. This practice will minimise the number of containers and reduce risk of spillage **(Commitment 8.10.2.1d)**.
- All mobile equipment and light vehicle servicing activities including wash down will be conducted on impermeable surfaces **(Commitment 8.10.2.1e)**.
- A wash down facility incorporating a concrete base and a triple interceptor style sediment and oil/grease removal system will be provided for the workshop facility **(Commitment 8.10.2.1f)**.
- Refuelling of mobile equipment will primarily be conducted on a sealed surface,

however some refuelling will take place within the open pits and siding stockpile area using a mobile refuelling vehicle **(Commitment 8.10.2.1g)**.

- The mobile refuelling truck will carry spill containment and cleanup material at all times and the driver will be trained in the use of these materials **(Commitment 8.10.2.1h)**.
- Explosives magazine will be constructed and operated in accordance with regulatory requirements **(Commitment 8.10.2.1i)**.
- A licence to Store Dangerous Goods will be obtained for the storage of diesel fuel on site **(Commitment 8.10.2.1j)**.

8.10.2.2 Landfill

Non hazardous wastes (inert and putrescible) will be disposed of on-site in a landfill site. This will be incorporated into the Helene 6/7 waste rock stockpile and will not result in additional clearing.

- The landfill onsite will only receive solid wastes classified as non-hazardous (inert and putrescible) **(Commitment 8.10.2.2a)**.
- The onsite landfill will be constructed and operated in accordance with the *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory* (EPA, 2003). It will consist of a trench type facility located on the Helene 6/7 waste rock stockpile, greater than 150 metres from any watercourse, and 400 metres from the site offices and workshops. Surface runoff will be diverted around the landfill trench and wastes will be covered with 150 millimetres of waste rock at least once per month **(Commitment 8.10.2.2b)**.
- Domestic waste from the accommodation camps and offices will be properly handled, transported to and disposed of in the onsite landfill **(Commitment 8.10.2.2c)**.
- Territory Iron will promote the reuse and recycling of waste packaging and construction materials, and used equipment/parts, tyres and metal to maximise resources conservation and value recovery, and minimise disposal in the onsite landfill **(Commitment 8.10.2.2d)**.
- Reusable pressurised containers and vessels will be returned to suppliers. Pressurised containers and vessels that are not reusable will be punctured using suitable equipment and disposed of in the onsite landfill **(Commitment 8.10.2.2e)**.
- Territory Iron staff and contractors will be trained in proper handling and disposal of waste material **(Commitment 8.10.2.2f)**.

8.10.2.3 Offsite Disposal

- Hazardous waste generated by the operation will be transported offsite to licensed waste disposal facilities. This is likely to include waste oil, grease, batteries and heavy equipment fuel filters **(Commitment 8.10.2.3a)**.
- Solutions drained from punctured pressurised containers and vessels will be managed as hazardous wastes and appropriately disposed of offsite **(Commitment 8.10.2.3b)**.
- Hazardous materials and wastes will be stored in appropriately labelled containers within bunded areas **(Commitment 8.10.2.3c)**. Containment areas will be constructed in accordance with the requirements of AS1940 Storage and Handling of Flammable and Combustible Liquids and AS 1692 Tanks for Flammable and Combustible Liquids.

8.10.2.4 Emergency Response

- An Emergency Response Plan will be developed for the project. This plan will contain information regarding appropriate response to chemical spillages, leaks, fires or explosions **(Commitment 8.10.2.4a)**.
- A representative of Territory Iron will be assigned to liaise with Pine Creek emergency services regarding hazards on site and response procedures **(Commitment 8.10.2.4b)**.

8.10.3 Impact Assessment

By implementing appropriate storage and handling measures in accordance with industry standards and practices, dangerous goods and hazardous substances used in the operations will not present a hazard or cause environmental harm.

No chemicals are required for the processing of ore. Hydrocarbons are the primary type of hazardous material anticipated to be required on site. Correct management through implementation of the above measures will ensure that adverse impacts are prevented or minimised.

8.11 TRANSPORT

8.11.1 Potential Issues or Impacts

Potential issues and impacts relating to transport include:

- Dust and road traffic noise.
- Potential road safety issues between mine traffic and other local traffic.
- Increased maintenance requirements of public roads.
- Increase in demands on railway and port infrastructure.

8.11.2 Management and Mitigation Measures

To ensure impacts of mine transport are minimised the following management actions will be put in place:

Pine Creek to Mine Traffic

- A commuter bus run will be employed to transport workers between Pine Creek and the mine. Regular bus runs will be limited to a maximum of three return trips per day **(Commitment 8.11.2a)**.
- Carrying out additional maintenance on stream crossings on the Mt Wells Road between Pine Creek and the mine as necessary to improve all-weather access **(Commitment 8.11.2b)**.
- Erecting warning signs at the junction of Frances Creek Road and Mt Wells Road to advise the public they are entering private property and must comply with all directions issued by Territory Iron. Discouraging casual access. Erecting fences and gates at this intersection if the public continues to access the mine area along this road **(Commitment 8.11.2c)**.

Ore Haulage from Mine to Darwin

- The intersections between the proposed haul route and Mt Wells Road will be constructed to DPI requirements **(Commitment 8.11.2d)**.
- The intersection specifications for Route 1 currently include:
  - Sealed road on the haul road for 100 metres either side of intersection, to assist stopping and reduce dust in the area.
  - Sealed road on the public road for 30 metres either side of intersection, to reduce dust, provide a surface for line marking, and delineate the change conditions for approaching motorists compared to the existing gravel surface on either side of crossing.
  - Reverse curves in haul road alignment to slow road trains down to safer approach speed.
  - Advance warning signs on public road as per Australian Standards,
  - Erection of boundary fences and gates on the boundary of the public road, for a short distance either side of the haul road, and leading back into the bush, to communicate the private nature of the haul road and to keep other users off the haul road.
  - Clearing to ensure good visibility of the intersection for trucks and public road users.
  - Strengthened pavement on haul road across public road reserve to reduce maintenance on this section of works which will become the property of the DPI.
- If Route 2 is adopted a similar specification of intersection will be constructed at both entry and exit points to Mt Wells Road.
- If Route 2 is adopted for ore haulage then the affected section of Mt Wells Road will be upgraded by Territory Iron to DPI standards including improved sight lines and water course crossings and appropriate signage **(Commitment 8.11.2e)**.
- Drivers will work in standard shifts. No long periods of continuous driving are required. Road train transport cycles to the mine will be about 70 minutes return including loading and unloading. Drivers will be able to leave the cabin during loading operations and have sufficient time to take coffee, meal or rest breaks **(Commitment 8.11.2f)**.
- Road train drivers will use radio communications to coordinate safe passing. Only one to two road trains will operate at any time **(Commitment 8.11.2g)**.
- Licensed road going vehicles will be used for haulage and standard axle loadings will be complied with **(Commitment 8.11.2h)**.
- Sufficient freeboard will be left at the top of all trailers when loading to ensure ore product can not spill **(Commitment 8.11.2i)**.
- A truck washdown facility will be installed at the mine at which all vehicles will be washed down and made free of product before leaving the site **(Commitment 8.11.2j)**.
- All road trains will comply with Australian road rules for noise emissions **(Commitment 8.11.2k)**.
- Territory Iron will comply with the requirements of the Port Corporation's Environmental Management Plan as these relate to their operations. Procedures will be

developed by Territory Iron to address unloading of rail wagons and management of the product stockpiles **(Commitment 8.11.2l)**.

8.11.3 Impact Assessment

Traffic impacts to Pine Creek as a result of mine traffic will be minimal due to the low number of vehicle movements. Daily vehicle movements will be limited to three return trips by commuter bus, 10 return trips by four wheel drive vehicle and two return trips by semi trailer or road train. No local communities are located within impact distance of the route. One residence can be accessed via the affected portion of Mt Wells Road, but it is not visible from the road.

Impacts due to ore haul road truck traffic if Route 1 is adopted will consist of 40 to 80 vehicle movements per day (up to one every 17 minutes), crossing the Mt Wells Road. The Mt Wells road has very low traffic density and the intersection design will enable safe crossing and minimal dust impact due to the sealed surface.

Impacts due to ore haul road truck traffic if Route 2 is adopted will consist of 40 to 80 vehicle movements per day (up to one every 17 minutes), traversing seven kilometres of Mt Wells Road, between Frances Creek Road and the Roney Siding turn off .The design of the intersections will enable safe crossing. The upgrading of section of Mt Wells Road used by ore haulage road trains will improve sight lines and watercourse crossings. The increased heavy traffic will have an adverse affect on tourist traffic using the road, but traffic is very light and warning signs and road improvements will keep the impact manageable.

Appropriate permits from relevant agencies will be obtained. Internal and local public roads will be maintained and upgraded to a suitable standard as agreed with the local councils or other stakeholders

The daily movement of iron ore trains on the railway will be a significant increase in rail traffic. This increase is welcomed by the railway operators as the railway is currently underutilised. Frieghtlink will construct a passing loop at Roney Siding and an additional storage road within the Darwin terminal to accommodate the extra traffic from Territory Iron and provide additional capacity and flexibility for other rail operations.

Port capacity is being expanded considerably to accommodate bulk handling such as that from Territory Iron and the extra traffic is welcomed by the port administration. Environmental impacts at the Port are not covered by this PER, but are addressed in an Environmental Impact Statement prepared for the Port Corporation and issued in 2003. The Port Corporation has developed an Environmental Management Plan (EMP) to ensure environmental impacts are prevented or minimised.

8.12 CULTURAL ENVIRONMENT

8.12.1 Potential Issues or Impacts

The cultural heritage survey completed in October 2005 indicated that the Frances Creek railway was the only European heritage object of value. The survey concluded that the heritage value of the railway would not be affected, as the proposed use is consistent with historical use of the area.

Potential Aboriginal cultural impacts include:

- Un-authorised destruction or damage to identified sites.
- Identification of additional Aboriginal sites or artefacts during the mining process.
- Increased levels of employment among the local indigenous population.

The Aboriginal sites survey did not include the proposed haul road route along the old spur line alignment.

8.12.2 Management and Mitigation Measures

Territory Iron will avoid unnecessary disturbance to any identified heritage and Aboriginal sites. Management and mitigation measures to achieve this include:

- An archaeological study of the Haul Route section from the mine to Roney siding will be completed before commencement of new road construction **(Commitment 8.12.2a)**.
- All employees and contractors will be required to participate in a general site induction before starting work. The induction will include:
  - Information on the importance of the cultural environment and protecting artefacts and archaeological sites.
  - Information on correct procedure if items of potential Aboriginal or heritage significance (including bones) are discovered during construction or mining activities **(Commitment 8.12.2b)**.
- The coordinates of artefact and archaeological site locations shall be stored in a suitable database by Territory Iron and be made assessable to project design, construction and operations personnel **(Commitment 8.12.2c)**.
- Archaeological sites close to disturbances (e.g. Ochre Hill 2 and 3) will be fenced off to protect them during operations **(Commitment 8.12.2d)**.
- The Northern Land Council and owners of the pastoral stations will be kept informed of planned operations **(Commitment 8.12.2e)**.
- Immediately advising the Northern Land Council, Aboriginal Areas Protection Authority (AAPA) and NRETA if an Aboriginal site or Aboriginal artefact is discovered **(Commitment 8.12.2f)**.
- No archaeological site will be disturbed unless approval has been obtained from AAPA, Northern Land Council and/or NRETA **(Commitment 8.12.2g)**.
- No isolated artefacts will be disturbed without approval from Territory Iron Operations Manager **(Commitment 8.12.2h)**.
- Mining shall not commence until the AAPA Authority Certificate has been obtained. All conditions attached to the certificate shall be complied with **(Commitment 8.12.2i)**.
- Territory Iron shall consider all applications for employment from the local indigenous population and in consultation with local Aboriginal groups shall investigate opportunities to provide assistance in training and mentoring **(Commitment 8.12.2j)**.

8.12.3 Impact Assessment

The Ochre Hill 1 Aboriginal site is in the proposed footprint of the Ochre Hill Pit. Territory Iron is in the process of obtaining a permit under section 29 of the Northern Territory *Heritage Conservation Act 1991* to remove artefacts from this site so that mining can occur. No mining activities will commence until approval has been granted and all artefacts have been recorded, removed and relocated. No other identified Aboriginal sites will be interfered with.

Through appropriate fencing, education of employees and implementing the management measures outlined above, adverse impacts upon Aboriginal cultural heritage will be minimised.

Positive impacts on local Aboriginal communities will arise from increased opportunities for employment, training and education. Continuing involvement and discussions with the Northern Land Council and local Aboriginal groups shall ensure that opportunities for positive impacts are maximised.

8.13 SOCIO-ECONOMIC ENVIRONMENT

8.13.1 Potential Issues or Impacts

Potential social and economic impacts include:

- Increased local employment in the Pine Creek area.
- Increased use of Alice Springs-Darwin Railway.
- Increased use of Darwin Port.
- Increased traffic movements as material is imported and exported from the project area.
- Increased contribution to the Northern Territory and Federal economies as a result of royalties and payroll taxes.
- Increased pressure on Pine Creek accommodation and medical services.
- Increased business opportunities for local business.
- Temporary change of land use from pastoral to mining.
- Potentially negative impact on tourism within the area.

8.13.2 Management and Mitigation Measures

Territory Iron activities will provide employment. Where possible, Territory Iron will obtain goods and services from the local economy where appropriate services or skills exist. Preference will be made for employment of local people.

Management and mitigation measures that will be implemented will include:

- On final decommissioning plant and infrastructure will be dismantled, made safe and unless requested otherwise by project stakeholders, removed from the site **(Commitment 8.13.2a)**.

- Compensation agreements will be reached with landowners for loss of use of land used by Territory Iron Limited for mining or associated infrastructure **(Commitment 8.13.2b)**.
- Employment opportunities will be advertised locally and preference will be given to local candidates **(Commitment 8.13.2c)**.
- Provision of goods and services will be advertised locally and preference will be given to local businesses **(Commitment 8.13.2d)**.
- First aid facilities will be established onsite for the duration of the project. These facilities will be manned by appropriately qualified employees **(Commitment 8.13.2e)**.
- A liaison will be established between onsite Emergency Response and First Aid personnel and providers of equivalent services in Pine Creek, Katherine and Darwin **(Commitment 8.13.2f)**.

8.13.3 Impact Assessment

Implementing the management and mitigation measures will result in a low risk of the project negatively impacting the socio-economic environment.

Employment from the Frances Creek project will provide a beneficial impact on the local communities, especially that of Pine Creek.

Increased traffic on the Stuart and Kakadu Highway will come from light vehicles as well as supply trucks. This is not anticipated to be significant, particularly as traffic on the highway has been reduced as a result of commissioning of the railway.

Use of port facilities in Darwin are not expected to result in any significant impact as management of the product will be subject to management and mitigation strategies detailed within the Port Authorities' environmental management systems.

Most of the workforce will already live in the region. Commitments to preferentially employ local candidates provide education and training to members of the local indigenous community and preferentially engage local goods and service providers will help to ensure the local community experiences project benefits.

Local land use will change during the life of the project from pastoral (stock grazing) to active mining. It will revert to pastoral when extraction is complete with land alienation of up to 500 hectares for the life of the project.

The project will provide an economic boost to the local area and Northern Territory economy through increased business opportunities for local businesses. Increased contribution to the Northern Territory and federal economies as a result of royalties and payroll taxes will result in a net benefit.

8.14 VISUAL AMENITY

8.14.1 Potential Issues or Impacts

The only potential issues are:

- Visibility of operations from Stuart and Kakadu Highways, Mt Wells Road, and Alice Springs to Darwin Railway.
- Increased use of Mt Wells public road.
- Visibility of permanent features after closure of operations.
- Distraction of highway users by lights.

8.14.2 Management and Mitigation Measures

Despite the low potential for impact on public visual amenity, Territory Iron aims to minimise the impact on the visual amenity of the project site. Management and mitigation measures to achieve this include:

- The impact of clearing will be minimised by restricting clearing of vegetation to the minimum necessary for operations **(Commitment 8.5.2.1c)**.
- Wherever possible, locating operations on areas already disturbed by previous mining operations **(Commitment 8.5.2.1d)**.
- Progressively rehabilitating areas wherever practicable. All rehabilitation will be in accordance with contemporary accepted industry-best practice and an approved MMP **(Commitment 8.2.2c)**.
- Access to the project site will be limited to employees and authorised visitors. All project access will be well signposted to control traffic movement in and out of the project area **(Commitment 8.9.2h)**.
- The waste rock stockpiles will be contoured so that they tie in with the surrounding topography. The maximum height will not exceed 45 metres and will be less than or equal to the height of existing ridges nearby, so that the final design is aesthetically pleasing **(Commitment 8.2.2b)**.

8.14.3 Impact Assessment

Project operations will not have a visual impact from the Stuart or Kakadu Highways other than from transportating product. The proposed Route 2 transport option includes seven kilometres of Mt Wells road which is a public road and a designated tourist route.

The final voids and waste rock stockpiles will remain at the end of the project. These will have a low visual impact following rehabilitation owing to the site's isolated location and the control measures to be implemented.

8.15 BITING INSECTS

8.15.1 Potential Issues or Impacts

Potential issues and impacts relating to biting insects are:

- Local transmission of mosquito carried diseases such as Malaria.
- Increase in adult mosquito populations to pest proportions.

- Reducing potential mosquito and biting midge habitat through covering the old tailings swamp with the Helene 5 waste rock stockpile.

8.15.2 Management and Mitigation Measures

Territory Iron is committed to ensuring the health and safety of its workforce. To ensure impacts from biting insects are minimised the following management actions will be put in place:

- During the site specific induction advising all employees of the potential for seasonal problems relating to biting insects including their potential pest, nuisance and disease carrying potential. All employees will be made aware of the diseases mosquitoes may carry **(Commitment 8.15.2a)**.
- During site specific inductions, all staff will be advised on personal protection measures to protect themselves from mosquitoes and other biting insects **(Commitment 8.15.2b)**.
- If mosquito breeding reaches significant levels, Territory Iron will liaise with the MEB to determine appropriate larvicides to use to control the problem **(Commitment 8.15.2c)**.
- After the 12 month adult biting insect trapping program, Territory Iron will review the findings and recommendations of the report produced by the MEB and decide on appropriate management responses **(Commitment 8.15.2d)**.
- Where employees are sourced or returning from countries or areas where malaria is endemic these employees shall be screened for malaria prior to entering the mine site **(Commitment 8.15.2e)**.
- Monitoring and control of biting insects shall be included as part of the Environmental Management Plan (**Commitment 9.15.2f**).

8.15.3 Impact Assessment

Education of employees, ongoing monitoring of mosquito populations and effective management of mosquito breeding grounds will ensure that any impacts associated with biting insects are minimised or avoided.

Risk Rating

In terms of impacts relating to the transmission of diseases such as malaria the likelihood of occurrence is considered to be E – Rarely. The consequence is 3 – Severe. This gives a risk rating of 2 – Negligible.

In terms of adult mosquito populations increasing to pest proportions the likelihood of occurrence is C – Moderate while the consequence is 2 – Minor. This gives a risk rating of 4 – Low.