Details of the construction and operation of the proposed modifications to the TSFs and proposed additional west dumps are provided in **Section 2.3**, and include:

- increase in the approved height of the Estcourt TSF from 25 metres to 28 metres above ground level;
- development of a new TSF 3, which will extend to the south from the southern embankment of TSF 2 to incorporate the approved TSF 3 (Rosedale) to a height of approximately 28 metres above ground, an increase from the approved height of 20 metres above ground level;
- development of additional waste dumps, including:
  - E26 waste material will be dumped adjacent to the existing E26 subsidence zone with an approximate area of 123 hectares and maximum height of approximately 25 metres above ground level; and
  - E28/E28N waste material will be dumped between the E28 and E28N open cut pits with an approximate area of 8 hectares and maximum height of approximately 30 metres above ground level.

Visually prominent features of the Project in the night landscape will be lighting associated with:

- continued use of existing ore transport and processing infrastructure, and mine site infrastructure areas including the main office and workshop complex located centrally in the Project Area and the underground offices located in the southern extent of the Project Area. This includes fixed lighting located on site buildings an infrastructure, and mobile lighting;
- open cut mining operations which may occur in the evening and night time period during mining campaigns which will include the use of mobile lighting plants focussed on specific work areas; and
- construction and operation of the TSFs including ongoing construction of wall raises which will include the use of mobile lighting plants focussed on specific work areas.

5.12.3 Viewing Locations and Assessment Methodology

The visual analysis undertaken for the Project has analysed the terrain of the Project Area and the surrounding area, including the identification of locations from which views of the Project may be possible. A radial topographic analysis technique was used to confirm the visibility of the Project based on ground topography alone. The radial analysis shows where potential views of the Project may be possible from the surrounding area based on terrain modelling undertaken for the Project. The radial analysis does not take into account localised visual screening from vegetation or structures such as buildings. Rather, it is used as a tool to identify areas with potential views of project components.

The radial analysis assessed the visibility of the prominent aspects of the Project including the proposed waste rock dumps and proposed modifications to TSFs, including modified footprint and height of TSF 3 and the increased height of Estcourt TSF.

Potential views of the Project were assessed from five locations within the Project Area associated with the visibly prominent aspects of the Project (refer to **Figure 5.28**). The specific locations for this assessment were chosen based on proximity to the closest private residences. The visual assessment locations (VL) utilised for the assessment are shown on **Figure 5.28** and are briefly described as follows:

- VL 1 – Estcourt TSF – including at the approved height of approximately 25 metres, and the proposed height of 28 metres above ground level;
- VL 2 – Northern edge of the TSF 3 Extension at the proposed maximum height of approximately 28 metres above ground level;
- VL 3 – South-eastern corner of TSF 3 – including at the approved height of approximately 20 metres and the proposed height of approximately 28 metres above ground;
- VL 4 – Proposed waste rock dump, east of the E26 open cut at the proposed height of approximately 25 metres above ground level; and
- VL 5 – Proposed waste rock dump, west of the E26 open cut at the proposed height of approximately 25 metres above ground level.

The assessment of visual impacts at each of these viewing locations considered characteristics of the existing landscape, sensitivity of viewers and the extent to which visual modification will occur as a result of the Project. Visual modification refers to visual changes that occur as a result of a development when compared with the existing visual landscape. The extent of visual modification is influence by various factors, including:

- Vegetation – tree height and density contributes to the visual quality of the landscape and can contribute to screening of visual impacts. Vegetation is highly fragmented in the areas surrounding the Project Area and generally occurs in localised areas including along public roads and property boundaries. Vegetation attributes of the surrounding area may change over the life of the Project.
- Topography – the relative topographical location of private residences and public roads to the Project Area, and intervening topography, such as localised areas of topographical relief, can limit the visual impacts. As the topography of the landscape surrounding the Project Area is generally flat with low general levels of relief, topographic effects are unlikely to substantially influence the degree of visual impacts.
- Distance – the relative distance from a private residence and public road to the Project Area will influence the degree of visual impact as it relates to perspective. Greater distance between receiver and visual feature can act to reduce visual impact as it will be less prominent in the view shed. Additionally, where a feature is in close proximity to a receiver, there is scope to mitigate visual impacts through localised treatments such as vegetation screens.
- Contrast – the impact of a visual modification is also influenced by the type of changes that are visible from a viewing location. These changes may include texture and colour of the components of the Project that may contribute to the visual impact, in the context of the existing environment.

Visual sensitivity takes into account proximity of the viewer of the Project and the perception or acceptance of potential changes to the landscape.

5.12.4 Visual Impact Assessment

As discussed in **Section 5.12.3**, visual impacts are dependent on characteristics of the existing landscape, sensitivity of viewers and the extent to which visual modification will occur as a result of the Project. The visual impact assessment is focused on the most sensitive receivers, such as private residences and local roads.

The radial analyses undertaken for the Project to assess the potential visual impacts on private residences and surrounding public roads are provided on **Figures 5.29** to **5.33**, with the assessment of potential impacts of visually prominent features of the Project is outlined below.

Tailings Storage Facilities

In regard to the potential visual impacts as a result of the proposed modifications to TSFs, it is noted that these structures would create a topographic high on land that is relatively flat. However, due to the long term presence of TSF 1, TSF 2, and Estcourt and that TSF 3 was approved as part of the E48 Project, this impact is considered relative to visual catchment of the existing and approved operations.

As shown on **Figure 5.29**, the approved Estcourt TSF has a visual catchment that is concentrated to the north of the Project Area, including areas further to north-west. **Figure 5.29** also includes the radial analysis from VL 1 from the proposed height of approximately 28 metres above ground. As shown on **Figure 5.29**, there are no substantive changes to the visual catchment associated with the proposed increased height of Estcourt TSF relative to approved operations.

The radial analyses for the existing and proposed modifications to TSF 3 are shown on **Figures 5.30** and **5.31**. The radial analysis from VL 2 includes the area of additional disturbance associated TSF 3 at the proposed height of approximately 28 metres above ground (refer to **Figure 5.30**). As shown on **Figure 5.30**, this area of TSF 3 would be visible in the area immediately east of the Project Area extending to the north-east (VL 2). The visual catchment of VL 3 of the existing approved footprint and height (20 metres above ground) for the TSF 3 facility substantially includes the visual catchment from VL 2 to the east and north-east of the Project Area (refer to **Figure 5.31**).

In addition, as shown on **Figure 5.31**, there are no substantial changes to the visual catchment associated with the proposed increased height of TSF 3 relative to the existing approved height. Accordingly, the visual catchment associated with the proposed amendments to the TSF 3 footprint and increase in height is consistent with existing and approved operations.

Waste Dumps

The potential visual impacts associated with proposed development of waste dumps in the vicinity of E26 in the southern extent of the Project Area are shown on **Figures 5.32** and **5.33**. As shown on **Figures 5.32** and **5.33** the proposed waste dumps will be visible predominately in areas to the south and south-west of the Project Area and extending to further distances to the west of the Project Area. This visual catchment includes a number of private residences, and public viewing locations, including public roads. Whilst the proposed waste dumps will be visible at private residences, the closest private residence is at a distance of approximately 2.5 to 3 kilometres from the Project Area.

Accordingly, private residences would only have relatively long distance views of this aspect of the Project indicating that it would be unlikely to have a significant impact on private residences. In addition, given the distance between the private receivers and the Project Area it is likely that features such as local vegetation, and areas of localised topographical relief, would reduce the visibility of these project components in the surrounding area.

McClintock's Lane is located immediately south of the Project Area and travels along the southern boundary of the proposed waste dumps. Accordingly the proposed waste dumps will be visible for road users along McClintocks Lane. McClintock's Lane is a local road which carries very low traffic and as it would only provide for relative short term views to limited number of road users; it is not considered a significant impact. Notwithstanding, NPM will assess the viability of undertaking localised plantings along the southern boundary of the Project Area to fill gaps in existing roadside vegetation and provide screening to McClintocks Lane.

As shown on **Figure 5.33**, there are potential limited views of the proposed waste dumps along Five Chain Lane, located approximately 5 kilometres to the west of the Project Area. There are intermittent views along an approximate 13 kilometres length of this road, which equates to a total viewing period of approximately 10 minutes (based on an 80 kilometres per hour speed limit). Given the short term nature of potential views, the distance from the Project Area, and the likely affect of localised areas of vegetation along this road, the potential visual impacts are considered negligible.

Night Lighting

As outlined in **Section 5.12.2**, there are a number of elements of NPM operations that are potentially visible at night. The majority of these areas including existing approved mine infrastructure that includes areas of fixed lighting. As outlined in **Section 2.3**, these are aspects of existing NPM operations which will continue for the life of the Project.

The proposed open cut operations, and construction and operation of TSFs during the night time period will require the use of mobile lighting equipment located in specific work areas. These construction works will contribute to the night time glow from NPM operations, but given the duration and intensity of the additional mobile plants operation, light generated from this source will be a relatively minor component of NPM's night time glow and due to the localised nature of these activities, and distance to surrounding private residences and public roads, any potential lighting impacts can be readily managed by NPM.

5.12.5 Visual Management Controls

NPM will implement the following mitigation measures to mitigate potential visual impacts from the Project:

- maintenance of existing vegetation where possible for visual screening, including infill planting where necessary;
- additional screening plantings will be utilised in strategically located positions to augment existing plantings and limit views into the Project from public roads, in particular McClintock's Lane;
- continued establishment of revegetation corridors outside the active mine area through ongoing land management practices;
- ensuring that areas of disturbance are kept to the minimum practicable at any one point in time;
- rehabilitation of disturbed areas is undertaken as soon as practical; and
- aiming to minimise night lighting impacts on surrounding land owners and road users by ensuring, where practicable, that lighting plants are positioned such that light is directed towards work areas and not towards private residences and roads.

5.13 Greenhouse Gas and Energy Assessment

The DGR's for the Project require a Greenhouse Gas and Energy Assessment (GHGEA) be undertaken, including a quantitative assessment of the potential Scope 1, 2 and 3 emissions associated with the Project; a qualitative assessment of the potential impacts of these emissions on the environment; and an assessment of reasonable and feasible measures to minimise greenhouse gas (GHG) emissions and ensure energy efficiency. Umwelt has prepared a detailed GHGEA for the Project, a copy of which is provided in **Appendix 14**. A summary of the key findings of the GHGEA is provided in this section.

5.13.1 Greenhouse Assessment Policy Context

There are a number of guidelines in place that outline the methods for undertaking a GHGEA. The assessment has been prepared in consideration of the guidelines, including:

- World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI) Greenhouse Gas Protocol 2004 (GHG Protocol); and

- National Greenhouse Accounts (NGA) Factors (2012).

The GHG Protocol provides an internationally accepted approach to the accounting and reporting of GHG emissions by entities. Under the GHG Protocol the establishment of operational boundaries involves identifying emissions associated with an entity's operations, categorising them as direct or indirect emissions, and identifying the scope of accounting and reporting for emissions.

Three 'Scopes' of emissions (Scope 1, Scope 2, and Scope 3) are defined for GHG accounting and reporting purposes. These scopes are briefly outlined below:

- Scope 1 emissions are direct emissions which occur from sources owned or controlled by the reporting entity, over which they have a high level of control (such as fuel use).

- Scope 2 emissions are those generated from purchased electricity consumed by the reporting entity, which can be easily measured and can be influenced through energy efficiency measures. Scope 2 emissions physically occur at the facility where electricity is generated (i.e. the power station).

- Scope 3 emissions are indirect emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another reporting entity (e.g. outsourced services). Scope 3 emissions are estimates only and may have a relatively high level of uncertainty, unreliability and variability.

5.13.2 Methodology

Scope 1 and 2 emissions were calculated based on the methodologies and emission factors contained in the NGA Factors 2012.

Scope 3 emissions associated with product transport were calculated based on emission factors contained in the National GHG Inventory: Analysis of Recent Trends and GHG Indicators (AGO 2007). Other Scope 3 emissions were calculated using methodologies and emission factors contained in the NGA Factors 2012.

The detailed GHG assessment considered the individual stages of the Project, as mitigation options can be developed for the construction, operation and closure stages of the Project.

5.13.3 Predicted Energy Consumption

Estimating energy consumption is an important component of establishing the GHG emissions profile of a Project. Outlined below is a summary of the predicted energy consumption for the Project based on the information provided by NPM:

- the construction of the Project is forecast to require approximately 62,000 Gigajoules (GJ) of energy;

- the Project's onsite energy requirements are forecast at approximately 15,630,000 GJ over 19 years of operations. Annual average energy consumption is forecast at 823,000 GJ per annum. The average energy intensity of the copper concentrate produced is expected to be approximately 8.43 GJ/product tonne; and

- the Project is forecast to consume approximately 197,900 GJ during the closure phase.

The energy usage over the life of the Project is shown in **Figure 5.34** and shows that a vast majority of the Project's GHG emissions will be generated by electricity consumption as part of ore processing.

5.13.4 Predicted Greenhouse Gas Emissions

Construction Phase

As the construction activities are likely to be out-sourced to third parties, all emissions resulting from construction activities will be Scope 3 emissions. The construction of the Project is forecast to be associated with approximately 8,409 tonnes CO2-e Scope 3 emissions. The breakdown of construction related emissions demonstrates that approximately 51 per cent of forecast construction related emissions are attributable to the consumption of construction materials. The consumption of energy during construction contributes approximately 39 per cent of construction emissions, while approximately 10 per cent of construction emissions are attributable to the transport of construction materials.

Operation Phase

The Project is forecast to be associated with approximately 4,324,000 tonnes CO2-e of GHG emissions over 19 years of operations. This includes Scope 1, 2 and 3 emissions.

Scope 1 emissions from the Project relate primarily from the combustion of diesel. The Project is forecast to generate approximately 174,000 tonnes CO2-e Scope 1 emissions during its operation phase. Annual average Scope 1 emissions are forecast at approximately 9200 tonnes CO2-e per annum.

Scope 2 emissions from the Project are those emissions associated with the production of electricity used by the Project. These emissions occur at the point of energy generation, not at the mine site. The Project is forecast to be associated with approximately 3,210,000 tonnes CO2-e Scope 2 emissions from consuming electricity during its operation phase. Annual average Scope 2 emissions are forecast at approximately 169,000 tonnes CO2-e per annum.

The Project is forecast to be associated with approximately 940,000 tonnes CO2-e Scope 3 emissions during its operation phase. Scope 3 emissions will be generated by third parties providing product transport and energy to the Project. Annual average Scope 3 emissions are forecast at approximately 49,500 tonnes CO2-e per annum.

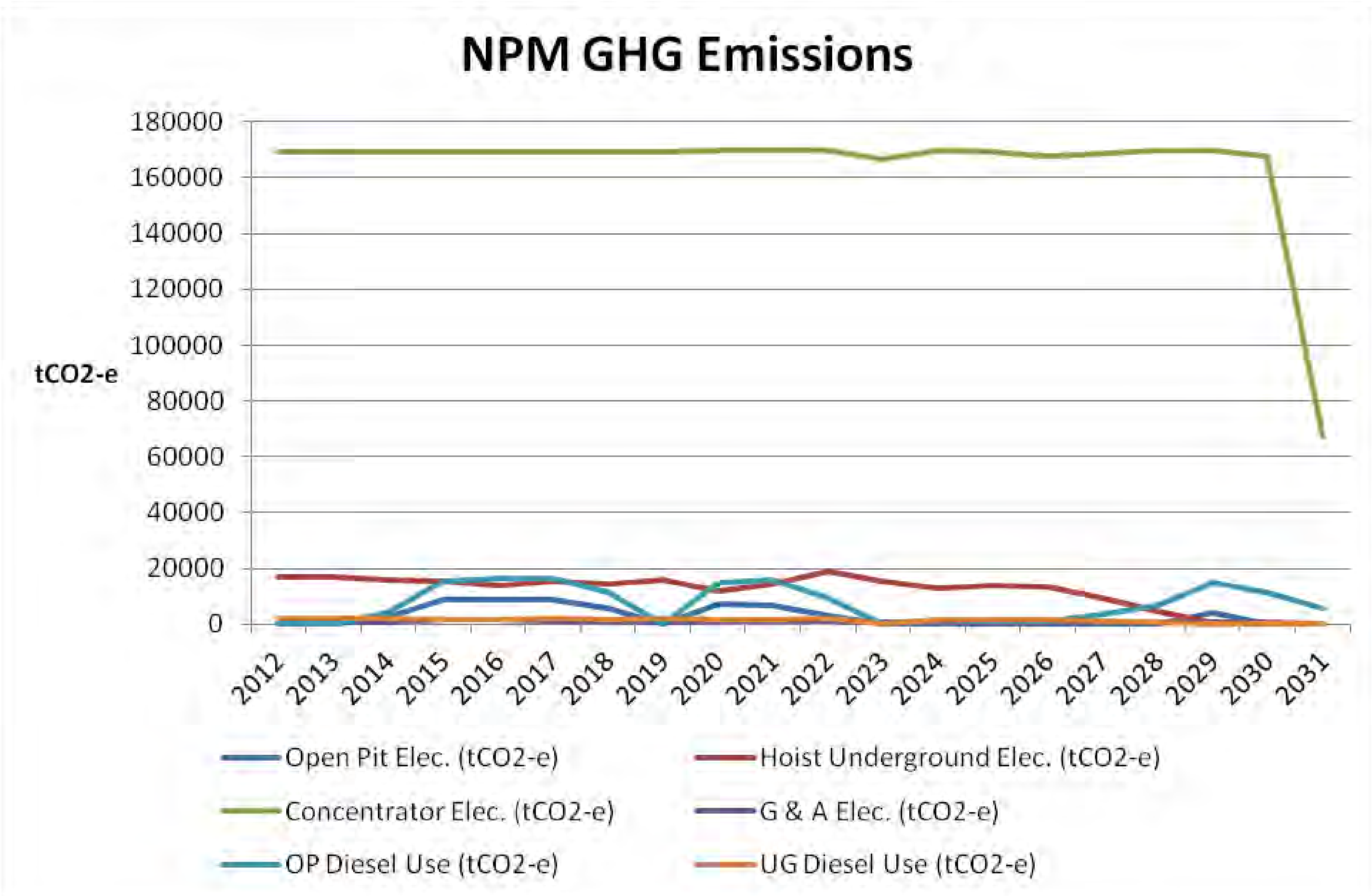

FIGURE 5.34

Forecast Greenhouse Gas Emissions by Operation

Approximately 96 per cent of GHG emissions will be produced beyond the direct control of NPM. Power stations generating electricity are the Project's predominant source of greenhouse gas emissions, so the Project's emissions will be heavily influenced by the electricity demands of the concentration process and the greenhouse gas intensity of electricity generation in NSW.

Scope 2 and 3 emissions have been included in the GHGA to demonstrate the potential upstream and downstream impacts of the Project. All Scope 2 and 3 emissions identified in the GHGA are attributable to, and may be report by, other sectors. That is, there is potential for these emissions to be double counted when compared to relevant benchmarks such as national or global emissions targets (e.g. Scope 2 emissions reported by NPM will also be reported by the electricity generator and contractors).

Closure and Rehabilitation Phase

The Project is forecast to generate approximately 13,800 tonnes CO_2-e Scope 1 emissions from diesel combustion during the closure phase. The closure phase is also expected to be associated with approximately 1050 tonnes CO_2-e Scope 3 emissions. Scope 3 emissions will be generated by third parties providing energy to the Project.

5.13.5 Impact Assessment

The GHG emissions generated by the Project have the potential to impact the physical environment and the GHG reduction objectives of national and international governing bodies. The following assessment makes the distinction between environmental impacts and impacts on policy objectives.

Quantifying the impacts of an individual project on the environment due to GHG emissions is difficult as such impacts are the result of emissions from a wide range of sources, not from an individual project. Project specific impacts are therefore commonly compared to global emissions (as outlined below) to assist in understanding the contribution of an individual project.

The Project's GHG emissions will have a disperse impact as they are highly mobile and are generated up and down the supply chain. GHG emissions primarily alter the atmospheric concentration of carbon dioxide and methane. The secondary impacts of GHG emissions include; global warming, ocean acidification and carbon fertilisation of flora. The tertiary impacts of GHG emissions (i.e. climate change) may have many ramifications for the natural and built environment.

The Project's direct emissions (Scope 1) are forecast to average approximately 9200 tonnes CO_2–e per annum. To put the Project's emissions into perspective, Australia's national greenhouse gas emissions are approximately 564,000,000 t CO_2 –e per annum and global GHG emissions are forecast to be 46,000,000,000 t CO_2-e by 2020 (Sheehan *et al* 2008). During operation, the Project will contribute approximately 0.0017 per cent to Australian and 0.000020 per cent to the global emissions per annum (based on its projected Scope 1 emissions). The Scope 2 and 3 emissions associated with the Project should not be considered in a global context, as global projections only represent Scope 1 emissions (i.e. the sum of all individual emission sources).

Impact on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) define climate change as a change in the state of the climate that can be identified by changes in the mean and/or variability of its properties, and persists for an extended period, typically decades or longer (IPCC 2007).

Climate change is caused by changes in the energy balance of the climate system. The energy balance of the climate system is driven by atmospheric concentrations of GHGs and aerosols, land cover and solar radiation (IPCC 2007). There is strong evidence to suggest that observations of global warming are directly correlated to increased concentrations of atmospheric GHGs (IPCC 2007).

It would be misleading to assess the climate change impacts of the Project by simply applying a radiative forcing coefficient to the greenhouse gases generated by the Project. Carbon emitted to the atmosphere is exchanged between carbon reservoirs such as oceans and ecosystems over a wide range of timescales. It is erroneous to assume that the GHGs generated by the Project will materially shift the atmospheric concentration of GHGs in a linear way (IPCC 2007).

The extent to which global emissions and atmospheric concentrations of GHGs have a demonstrable impact on climate change will be largely driven by the global response to reducing total global emissions that includes all major emission sources and sinks.

Impact on Policy Objectives

The Australian Government has committed to reduce Australia's GHG emissions by 5 per cent from 2000 levels by 2020 irrespective of what other countries do, and by up to 15 or 25 per cent depending on the scale of global action.

If Australia is able to meet the 5 per cent reduction target by 2020, the nation will be generating approximately 525 Mt CO_2-e per annum (National GHG Inventory 2010).

The Project is forecast to generate approximately 16,500[5] t CO_2-e Scope 1 emissions per annum by 2020. The Project's annual Scope 1 emissions are forecast to represent approximately 0.003 per cent of Australia's national emissions by 2020. The Project's Scope 2 and 3 emissions should not be considered against national objectives, as Scope 2 and 3 emissions (which occur in Australia) will be reported by other sectors of the Australian economy.

The Project is unlikely to limit the Federal Government achieving its national GHG objectives.

5.13.6 Greenhouse Gas and Energy Management

The GHG assessment is required by the DGR's to assess reasonable and feasible measures to minimise the Project's GHG emissions. The term reasonable incorporates notions of costs and benefits, whereas the term feasible focuses on the more fundamental practicalities of the mitigation measures, such as engineering considerations and what is practical to build or operation.

5.13.6.1 Evaluation of Management Measures

Rio Tinto triggers the energy use thresholds of the Energy Efficiency Opportunities (EEO) Program and it is therefore required to undertake energy efficiency assessments and report the progress of energy efficiency projects. NPM currently complete energy efficiency assessments, undertake energy efficiency planning and assist Rio Tinto to report on the progress of nominated energy efficiency projections. NPM will continue to participate in the EEO Program and undertake a range of activities to improve energy use efficiency.

[5] Note that this value is based on forecast activity data for 2020 and not annual average data.

Specifically, the GHG assessment evaluated the Project's planned GHG mitigation measures against what may be considered best practice. The evaluation considered 32 management measures, which were selected for applicability to NPM's operations. The evaluation found that the Project is planning to implement 20 of these measures as they are both technically feasible and likely to be financially reasonable. As the majority of projected GHG emissions from Project are related to Scope 2 emissions associated with electricity use, the mitigation measures have focussed on energy efficiency design and processes at the ore concentrator (which accounts for 87 per cent of electricity consumption).

Table 5.24 provides an overview of the reasonable and feasible mitigation and management measures that will be implemented as part of the Project. The detailed evaluation of all measures is provided in **Appendix 14**.

Table 5.24 – Reasonable and Feasible Mitigation Measures

Proposed Energy Mitigation Measure	Detail of Measure and Justification for Inclusion
1. High efficiency motors	High efficiency motors are used for all replacements and upgrades. Cost efficiencies do not warrant premium efficiency motors.
2. Optimising ore throughput	Optimising ore throughput is a key performance indicator for NPM. NPM have introduced a second crusher to optimise the performance of the SAG mill.
3. Optimising grind size	Grind size is constantly monitored and adjusted to optimise copper recovery.
4. Utilising Variable Speed Drives (VSDs)	VSDs are installed on all motor replacements and upgrades. NPM have determined that it is not cost effective to retrofit VSDs to older equipment.
5. Optimising motor size to load	The concentrator plant is operating at maximum capacity. All motors are running at close to maximum load capacity.
6. Mechanical efficiency of driven equipment	NPM have retrofitted all belt driven pumps with matched v-belt sets to reduce slippage losses.
7. Removing flow restrictions	The widespread use of VSD has reduced the need to mechanically restrict flow.
8. Hoist - Friction winder system	Allows significant energy savings by utilising counter weights and tail ropes.
9. Conveyors – high efficiency motors	High efficiency motors are used for all replacements and upgrades.
10. Conveyors – VSDs	VSDs are installed for all motor replacements and upgrades. NPM have determined that it is not cost effective to retrofit VSDs to older equipment.
11. Conveyors – low rolling resistance pulley covers	NPM has installed new conveyor belts that use a pulley cover compound that reduces rolling resistance and energy use.
12. Limiting the length of material haulage routes	NPM plan to make haul roads as short as practically possible. NPM also plan to use a direct dump strategy for overburden. E31 and E31N waste rock will be transported directly to the location of TSF 3 wall construction. This direct dumping will reduce double handling and total haulage distances.
13. Optimising ramp gradients	Ramp grades are designed to maximise safely and optimise fuel use efficiency.
14. Maximising payload	Trucks will be operated at maximum payload.
15. Scheduling activities so that equipment and vehicle operation is optimised	The mine planning process has scheduled activities to optimise the productivity and efficiency of equipment.

Table 5.24 – Reasonable and Feasible Mitigation Measures (cont.)

Proposed Energy Mitigation Measure	Detail of Measure and Justification for Inclusion
16. Using fuel additives	NPM have evaluated diesel additives and plan to use them during on-going operations.
17. Blasting strategies to improve extraction efficiency	Optimising blasting strategies is an important aspect of the NPM operation. NPM vary the power factor of each blast to optimise both digging and crushing performance.
18. Maximising resource recovery efficiency	Resource recovery will be optimised within the constraints of the Project.
19. Working machines to their upper design performance	Machines will be worked to their upper design performance. Optimising machine performance is a key performance indicator for operators.
20. Preventing unnecessary water ingress	NPM plan to bund all open pit areas.

5.14 Subsidence Management and Monitoring

The term ‘subsidence’ generally refers to the range of ground movements which result from underground mining operations.

In hard-rock mining operations, subsidence can either occur deliberately (e.g. block cave mining) or as an unplanned event (e.g. slope collapse). As outlined in **Section 2.0**, the subsidence zones are a result of the block-caving method used in underground mining; as the nature of the block-cave method result in subsidence which directly impacts the land surface resulting in relatively predictable disturbance footprints above underground mining operations (refer to **Section 2.2.1**).

The areas of the Project Area affected by subsidence associated with existing approved underground block cave mining are shown in **Figure 1.3**. The E26 subsidence zone is located at the southern end of the Project Area, with a current surface area affected by block-cave mining of approximately 20 hectares, which consists of a subsidence crater approximately 500 metres in diameter and 200 metres deep.

The E48 subsidence zone is located centrally in the Project Area and is similar in appearance to the E26 subsidence zone. The subsidence zone associated with E48 is forming with the continued development of block cave mining operations in this ore body. Predictive modelling indicates that the subsidence zone associated with the approved E48 operations will be approximately 68 hectares. A safety buffer of 50 metres is included as part of the E48 subsidence zone, resulting in a total subsidence affectation area of 84 hectares. The depth of the final subsidence crater is predicted to be between 125 metres and 200 metres deep.

The proposed extension of underground block cave mining into the E22 ore body will result in subsidence impacts in this area. As outlined in **Section 2.3**, existing disturbance areas associated with previous open cut mining within E22 is located directly above the proposed E22 block cave mine. Accordingly, it is anticipated that subsidence effects from the proposed E22 block cave mine will be limited to previously disturbed areas.

5.14.1 Subsidence Management Strategies

The subsidence management strategies relating to the natural and built features within the existing and proposed underground mining areas include:

- fencing and signage:
  - NPM will continue to keep subsidence zones secured from unauthorised access through the use of a 1.8 metre high cyclone mesh fence, which will be installed around the perimeter of the subsidence zone and outside of the associated exclusion zone;
  - signage will also be located at regular intervals along the security fence line;
- revegetating the areas surrounding the subsidence voids with trees and plants to assist in reducing the potential for soil erosion into the void where practicable;
- post-closure:
  - undertaking specific measures to provide for long term stability and safety of subsidence zones, as informed by geotechnical monitoring program implemented over the life of the Project; and
  - maintaining security fencing surrounding each void in perpetuity to prevent access and thus minimise the potential risks for human or fauna harm.

5.14.2 Subsidence Monitoring Measures

To monitor and assess the potential subsidence impacts on surface, natural and built features, subsidence monitoring will involve the following:

- Undertaking groundwater investigations to determine the quality of water expected to remain in subsidence voids, and the potential fluctuations in water level with time, including consideration of geotechnical implications and the potential use of void water storages by flora, fauna and people.
- Undertaking refinement of predictive groundwater modelling to confirm if and when 'equilibrium' void water levels will be reached, to determine whether the voids would act as groundwater sources or sinks and the risks associated with the voids overtopping during an extreme rainfall event.
- Undertaking geotechnical assessments of the final void walls/slopes to determine the long term stability of the landforms and to establish a time frame for the establishment of safe landforms, taking into consideration the effects of fluctuating water levels.
- Completion of regular geotechnical monitoring in accordance with the existing ground control management plan.
- Conducting visual inspections within the existing and proposed underground mining areas to assess potential subsidence impacts and to identify any potential remediation that may be required.
- Post-closure:
  - routine inspection and maintenance (if required) of security fencing to ensure its integrity and safety;

- monitoring of groundwater and pit water levels and quality (if safe to do) for comparison against predicted levels and quality;
- monitoring of geotechnical stability over an area of probable mining subsidence; and
- monitoring of slope movement in the walls of the open cuts using an appropriate method such as survey prisms, land base photography, aerial photography, or satellite monitoring.

The results of the monitoring program will be communicated to the respective stakeholders through the Annual Review.

5.15 Waste Management

Waste management has been identified as a key environmental issue in the DGR's for the Project (refer to **Section 1.3**). The specific details of the DGR's in relation to waste management include:

- accurate estimates of the quantity and nature of potential wastes streams from the development, including tailings, leachate and acid generating potential (refer to **Section 5.15.1**);
- an assessment of the construction, operation and final landform of proposed waste rock emplacements and TSFs;
- a leachate disposal strategy (refer to **Section 5.15.1**); and
- a description of measures that would be implemented to minimise production of other waste, and ensure that waste if appropriately managed (refer to **Section 5.15.2**).

An assessment of each of these requirements is provided in the following sections. As noted in **Table 1.1**, the assessment of the construction, operation and final landform of waste emplacements and TSFs has been undertaken in various detailed assessments as detailed in **Section 5.0**.

For the purposes of this assessment, waste streams at NPM can be broadly divided into two categories including mineral waste, including waste rock from mining activities and tailings from ore processing, as well as non-mineral wastes. Further details on these waste streams and management measures are provided in the following sections.

5.15.1 Mineral Wastes

5.15.1.1 Waste Rock

Characterisation

The ore to waste delineation at NPM is a function of an economic cut-off associated with target ore concentration levels. The ore bodies at NPM are gradational without hard lithological boundaries confining mineralisation. Hence it is the 'economic value' of the mineralization which determines whether it is classed as 'ore' or 'waste'.

Characterisation of ore has been undertaken since the mid-1980s and a large number of net acid generation (NAG) tests have been conducted. These tests are currently carried out on development waste rock, with each drive being tested two to three times per month. The large majority of these tests give NAG titration results to pH 7 that are below the detection limit, indicating that the waste is very unlikely to produce acid. Most of the sulphide minerals present in the ore report to the concentrate during processing, with the tailings containing on average about 0.2 per cent sulphur (RTTI 2011).

Much of the waste rock has come from the weathered horizon and consequently contains little intact sulfide minerals. Waste rock from the underground development drives may have a greater propensity to contain sulphide minerals, but typically these materials give NAG test results below the detection limit.

The Rio Tinto environment standards, E3 – Acid Rock Drainage Prediction and Control (RT 2008a) and 'E8 – Mineral Waste Management' (RT 2008b), require that regular reviews of operational management plans for acid rock drainage and the chemical hazards associated with mineral wastes are conducted at least every four years.

As indicated above the results of NAG test work conducted at NPM indicates that predominantly all wastes have a low potential to become acid generating. Both the NPM ore and waste are low acid generating due to overall low sulphide content and the presence of carbonate minerals in the rock. In addition, the regular testing and monitoring indicate that waste material have a high acid neutralisation capacity, which testing indicates is more than adequate to offset the low risk of acid generation.

An internal review of acid rock drainage was conducted by Northparkes (NPM 2006). The conclusions reached by the review supported the previous review findings that acidic drainage is not a significant issue at NPM. Similarly, the most recent review undertaken (RTTI 2011) also identified that the risk of acid drainage from waste rock is low.

The reviews have identified that neutral drainage from the release of sulfate (salinity) and metals/metalloids that are soluble at near neutral pH from waste rock emplacements required additional investigation, where relevant, management. NPM have commenced a process of staged characterisation of drainage, based on indicators both for neutral mine drainage, modelling, and subsequent updating of management plans and strategies as required. Details of the results of this process will be reported in the Annual Review for the Project.

NPM is a 'nil discharge' site with all drainage relevant operational areas captured in the existing contaminated water management system and incorporated into the water management practices on site. As described in **Section 5.8**, additional disturbance areas associated with the project, including additional waste rock emplacements will be incorporated into the water management system on site.

Quantity

Waste rock is produced from the open cut operations and the underground development drives. The quantity of waste rock produced from both these operations has been determined from the production schedule based on an 8.5 Mtpa scenario. In summary, over the life of the mine, approximately 42 Mt would be produced from the open cut operations, while approximately 4 Mt would be produced from the underground operations. As outlined in **Section 2.3**, the waste materials associated with open cut and underground operations will be available for providing a low grade ore stream into the ore processing plant or use in the construction of the TSFs as part of the Project.

5.15.1.2 Tailings

Quantity and Nature

Tailings to ore ratios range in the order of approximately 0.93 to 0.98 based on the target ore grades and copper concentrate product characteristics. The existing and proposed TSFs are designed to have a capacity to store approximately 122 Mt of tailings over the life of the Project.

The typical NPM tailings composition is summarised in **Table 5.25**.

Table 5.25 – Typical Tailings Composition

Chemical	Concentration (%)
Orthoclase $KAlSi_2O_8$	69
Silica, Crystalline – Quartz SiO_2	<18.1
Additives	6.4
Illite	3
Mica	2.3
Aluminium Silicate $Al_2O_3SiO_2$	0.9
Water	<1
Copper Sulphides	0.2

Tailings typically contain residual copper content, the host minerals, sulfate, chloride, calcium, magnesium and sodium, and a small amount of pyrite (RTTI 2011). Residual sulfur content in the tailings is approximately 0.2 per cent.

Leachate Management

NPM has developed a leachate management system for existing TSFs to capture seepage, and will continue to be utilised over the life of the Project. The seepage from TSFs is collected in a series of drains and dams located within the Project Area, with captured leachate incorporated into the water management system on site (refer to **Section 5.8**).

Seepage collection ponds and drains will be constructed downstream of the modified TSF 3 as part of the Project. The seepage control system will generally comprise:

- continuous 3 metre wide toe drain (crushed rock) along the upstream toe of the low permeability starter dam;
- 300 metre long section of rockfill leaky dam for each TSF; and
- 300 metres long and 100 metres wide blanket drain on the upstream side of each leaky dam section.

The toe drain and blanket drain will be constructed of 1 metre thick crushed rock (50 millimetres) wrapped in a geotextile filter. All of the seepage collected is incorporated into the contaminated water management system as detailed further in **Section 5.8**.

The existing and proposed TSF are designed and constructed to minimise seepage to the environment, in accordance with relevant design requirements and guidelines. The nature of the land beneath the TSFs, including the groundwater resources, are characterised by low infiltration and groundwater movement. As such, there is a low risk seepage from TSFs to the surrounding environment. The hydrochemical characteristics of the regional groundwater suggest that dissolution and other processes relating to seepage are not likely to change the total dissolved salts content in the regional aquifers in a significant way. It is therefore unlikely that any measurable change in regional groundwater quality would be observed as a result of the proposed mining operations (MER 2006). NPM currently monitor groundwater in the vicinity of TSFs, which will be extended to include the areas in the vicinity of TSF 3, as detailed further in **Section 5.7**.

In addition, final design of the TSFs, including capping will be managed through on site rehabilitation activities targeting the mitigation of impacts on surface and groundwater quality, and focus on the successful establishment of a stable landform that aligns with final land use requirements.

5.15.2 Non-Mineral Waste Management

All non-mineral waste on site is managed in accordance with NPM Sitewide Non-Mineral Waste Management Plan (NPM 2010b). The Plan applies to all non-mineral waste generated on site and includes the collection, transport, treatment, recycling/reuse, final use/disposal and where applicable, the supervision and maintenance of final waste facilities.

The objectives of the plan align with Rio Tinto's waste management hierarchy as follows:

- waste avoidance and reduction at the source;
- reuse and recycling; and
- waste treatment and/or disposal (as a last resort).

The following management measures are implemented on site to ensure adherence to the hierarchical management of non-mineral waste on site.

5.15.2.1 Training

NPM waste management requirements are incorporated into several existing induction and awareness training systems for all staff and contractors. Specific training is received by environmental high-risk roles in accordance with relevant NPM processes. In addition, the site waste management contractor is required to conduct waste awareness training on site.

5.15.2.2 Waste Inventory

NPM maintains a 'Non-Mineral Waste Inventory' which contains information on all non-mineral wastes generated, handled and disposed of, both on and off-site. The inventory also focuses on procedures for the safe storage, handling, treatment, recycling and disposal of non-mineral wastes.

5.15.2.3 Storage and Containment

Where practical, all wastes are segregated at source to improve recycling and recovery of materials, while waste storage and recycling areas are clearly identified by signage and labelled for approved materials within each department at the mine site. The location of each waste storage and recycling facility across the site is maintained within the NPM GIS system.

Hydrocarbon storage and containment areas are designed to meet AS1940 - The Storage and Handling of Flammable and Combustible Liquids.

In addition, NPM maintains a contaminated sites register (ref: A569398) that records, among other things, the location, establishment, activities, contaminants, records of sampling/ inspection, a risk assessment and preventative measures/remedial actions for each site that stores potentially hazardous/contaminating materials with the NPM operations area. At present a total of 59 sites are recorded and managed under the register.

5.15.2.4 Waste Disposal

Quantities of all non-mineral waste are tracked through the NPM Environmental Data Collection Spreadsheet for wastes collected on site and disposed of offsite at licensed waste disposal facilities.

The onsite landfill (Braeside Landfill) was decommissioned in May 2009 in accordance with DECC (NSW) Environmental Guidelines. The facility is documented within the Contaminated Sites Register (A569398).

5.15.2.5 Transport

The movement of Hazardous, Industrial or Group A classes of waste is recorded by NPM in accordance with the NPM EPL and requirements of the PoEO Act and the *Waste Minimisation and Management Act 1995*. The EPL and legislative provisions require that NPM properly classify the waste, use a licensed transporter where the waste to be transported is industrial or hazardous and ensure the waste is taken to a suitable waste treatment or disposal facility.

Records are kept of the name and license number of the waste transporter, destination facility, quantity (in tonnes) of material transported and interstate destinations.

5.15.2.6 Monitoring

Operational staff within each NPM department are responsible for managing waste handling and storage facilities. Quantities, including hazardous materials (e.g. waste oil/grease), are monitored accordingly by operational staff and collection schedules are arranged as required.

Onsite Facility Inspections

Inspection of onsite facilities for waste storage, treatment and disposal is undertaken on a regular basis to ensure compliance with procedures that cover waste management practices including general housekeeping, hydrocarbon management and battery storage. These facility inspections are incorporated into existing workplace inspections and carried out by the relevant area personnel in accordance with site standards/procedures as outlined in the NPM ESH Inspections Standard Operating Practice.

Internal Compliance and Systems Audits

HSEQMS audits are conducted on a site wide level as detailed in NPM Performance Audit and Review System and incorporate relevant waste management procedures and facility compliance.

Offsite Waste Facility Audits

Periodic audits of all offsite waste facilities are undertaken as part of the inventory implementation, in accordance with the NPM Non-Mineral Waste Treatment Audit Protocol.

The frequency of audits is based on the level of risk and is undertaken at a minimum of four yearly intervals for all waste facilities.

Verification audits are conducted periodically of contractor waste management/treatment facilities. The audits verify that wastes are dealt with safely and meet NPM expectations with the necessary approvals in place.

5.15.2.7 Waste Spillage

Cleanup of spillage from environmentally hazardous wastes is conducted in accordance with NPM Spill Response Standard Operating Procedure. The frequency and size of hydrocarbon spills on site is recorded through NPM Rio Tinto Business Solution reporting system. Details of any spills and remedial actions undertaken are recorded in the NPM contaminated sites register (refer **Section 5.15.2.3**).

5.15.2.8 Reporting

Operational non-mineral waste management is reported by NPM Environmental Section to Rio Tinto annually through the Environment Workbook of the Rio Tinto Social and Environment Survey. The workbook is designed to collect consistent annual HSE data (including non-mineral wastes) by Rio Tinto operations and to relate these inventories to production and activity levels. Items that are tracked include: non-mineral waste inventory, hazardous waste and waste data quality.

In addition, waste management and minimisation at the NPM operations are reported annually through the AEMR in accordance with Condition 34, Schedule 3 of PA 06-0026.

5.15.2.9 Review

The NPM Sitewide Non-Mineral Waste Management Plan (NPM 2010) is reviewed and updated annually or in the event of a significant operational change.

5.16 Hazard

5.16.1 Hazardous Materials Management

NPM uses a range of hazardous substances on site for mining operations and in the ore processing plant. The mining operation utilises various Class 1 explosive materials which are stored in several locations on site. Other substances stored on site include liquefied petroleum gas, Class C1 combustible liquids (e.g. diesel), Class 8 corrosive substances and Class 5 oxidising substances. Storage details including maximum stored quantities and storage locations for all substances are listed on the Acknowledgement of Notification of Dangerous Goods on Premises (acknowledgment number 35/029083) issued by WorkCover NSW. **Table 5.26** contains an inventory of the dangerous goods stored on the NPM site.

Table 5.26 – NPM Dangerous Goods Inventory

Material	Storage Depot	ADG Code Class (PG)	Present Storage Capacity (t)
Potassium Amyl Xanthate	4	8 (4.2 (III))	27
Caustic Alkali Liquid N.O.S.	4	8 (II)	20
Sodium Hydrogen Sulphide Solution	4	8 (II)	93
Nitric Acid	4	8 (II)	28
Explosives	5A	1.1D	60
Explosives	5B	1.1B	50,000 detonators
Explosives	5C	1.1B	15,000 detonators
Explosives	5D	1.1D	20
Explosives	5E	1.1D	7.5
Explosives	5F	1.4S	7.5
Explosives	5G	1.1B	25,000 detonators
Oxidising liquid, N.O.S.	6	5.1	60
Oxidising liquid, N.O.S.	8	5.1	30
Diesel	1	C1	9.5
LPG	2	2.1	4.4
Diesel	3	C1	95
Diesel and Mobile Plant Fluids	7	C1	142

The Project will not result in an increase in the quantities of hazardous materials stored on site, change to the location of the hazardous materials storages or changes the frequency and quantity of hazardous materials transported to the site. All dangerous goods will continue to be stored and handled in accordance with relevant Australian Standards and the Australian Dangerous Goods Code.

Hazardous materials are managed on site according to Rio Tinto HSE standards Occupational Health standard B4, Hazardous substances (OH-B40) and E5 - Hazardous materials and contamination control (E5). OH-B4 covers hazard evaluation, control program and control program evaluation design to ensure employees, contractors and third parties will not suffer adverse health effects from for dangerous goods and hazardous substances. E5 is intended to prevent spillage and environmental contamination from handling, storage and processing of materials in addition to the management of contaminated sites.

The NPM Management Plan Hazardous Substances and Contamination Control (HSCC) along with a range of standard operating procedures detail site specific requirements for the purchasing, handling, storage, production and use of hazardous substances and dangerous goods onsite. Review and, where required, update of the HSCC Management Plan is undertaken on an annual basis.

The objectives of the HSCC Management Plan are to outline how NPM will:

- minimise the number of environmentally hazardous substances spilt on site;
- reduce the impact from spilt environmentally hazardous substances;
- minimise the risk of adverse health effects to employees, customers, contractors and the public due to the exposure to hazardous substances and dangerous goods used as part of the NPM operation;

- manage hazardous substances to ensure corporate and statutory requirements are met; and
- provide employees and contractors with guidelines for the management of environmentally hazardous substances.

The key aspects of the HSCC Management Plan is summarised in **Table 5.27**.

Table 5.27 – NPM Hazardous Substances Management

Aspect	Management Methodology
Approval of New Substances	The request process for the introduction of a new hazardous substance to the NPM site is managed through a standard operating procedure (SOP). A risk assessment is conducted on the intended usage of the substance to enable decisions to be made about appropriate control measures, training, monitoring and health surveillance that may be required.
Documentation	NPM utilises ChemAlert to maintain a hazardous substances register and is kept up to date by the NPM Health section of the Environment Health and Safety (EHS) department. All employees with potential exposure to hazardous substances are provided with access to the register.
Transport, Storage and Labelling	All dangerous goods and hazardous substances are to be delivered to site by a suitably licensed transport company with appropriately trained personnel in accordance with the Australian Dangerous Goods (ADG) Code. All materials that are requiring bunded storage are to be immediately transferred to the compliant storage location upon delivery. All dangerous goods and hazardous substances are to be stored and labelled in accordance with relevant legislative requirements.
Handling	Detailed SOP's for the handling of hazardous substances cover the following: • incompatibility with other substances; • precautions when pouring, decanting and transferring; • emergency spill procedure; and • personal protective equipment to be used.
Training	Employees who have the potential to be exposed to hazardous substances and dangerous goods are provided with the following training: • hazard recognition; • handling of hazardous substances; • limits of exposure; • symptoms of exposure; • first aid and treatment of exposure; and • general dangerous goods training. Individuals who approve the introduction of hazardous substances to site are trained in the risk assessment hazardous substances. Employees involved in purchasing are trained in the use of ChemAlert to check the approved substances register.

Table 5.27 – NPM Hazardous Substances Management (cont.)

Aspect	Management Methodology
Monitoring and Audits	The Environment section of the EHS Department conduct site inspections to ensure the integrity of storage bunds and compliance with storage requirement. Chemical audits are conducted annually to ensure compliance with storage requirements and ensure the hazardous substance register is up to date.
Accountability	General role responsibilities for the management and handling of hazardous substances and dangerous goods include: • The ESH Manager is to ensure all personnel responsible for approving new substances are suitably trained. • The IT Superintendent is to ensure site wide access to the ChemAlert system. • The Supply Coordinator is to ensure that all purchasing officers are suitably trained in the use of the ChemAlert system. • Supervisors are to ensure personnel working with hazardous substances are suitably trained. • Employees working with hazardous substances must be familiar and comply with the HCSS Management Plan.

Given the hazardous substances and dangerous goods to be stored and handled at the NPM site will remain unchanged for the Project, the level of risk posed to off-site land users will remain unchanged from the present operation. The ongoing implementation of NPM's extensive hazardous substances management system ensure risks posed to surrounding land users by the introduction of any new hazardous substances or dangerous goods will be identified and managed.

5.16.2 Bushfire Hazard Management

Due to the existing mining activities and surrounding agricultural land use the majority of the Project Area and surrounding land is significantly cleared of vegetation. There are a number of areas of the Project Area identified as being partially bushfire prone by the PSC Bushfire Prone Land Mapping System in accordance with Section 146 of the EP&A Act. Key areas of vegetation across the site include Limestone State Forest with isolated tracts of vegetation generally confined to the margins of cultivated fields and areas identified as being less suitable for cultivation. Whilst there is minimal linkage between these areas of vegetation, the vegetation does represent a potential fuel load capable for sustaining and promoting the spread of bushfire, with the most significant and common bushfire threat to the site being grass fires.

Existing Bushfire Management

Onsite land management activities are currently undertaken in accordance with the NPM Landscape Management Plan which incorporates mine closure, final void management and rehabilitation management as well as general land management practices including bushfire threat management measures. The existing bushfire management measures implemented at the site include:

- maintenance of designated firebreaks through a combination of grading and spraying;
- provision and maintenance of onsite fire fighting equipment;
- appropriate management of hazardous materials;

- fire fighting training and awareness provided to relevant personnel, including an established onsite Emergency Response Team;
- permits for all hot work are issued before the commencement of works in accordance with the Hot Work Permit SOP; and
- consultation with the NSW Fire Brigade and RFS, as required.

Water for use in fire fighting is provided for by the site water management system, to ensure that there is sufficient water available on site for bushfire fighting purposes. The quantity of water available on site for the purposes of bushfire management is considered adequate.

Bushfire Threat Assessment

A bushfire threat assessment involves assessing the vegetation formations and the slope of the land to determine the appropriate Asset Protection Zone's (APZ's) required in accordance with the methods in Planning for Bushfire Protection (PBP) 2006. It is noted that PBP 2006 was developed to provide a guide to the necessary planning considerations when developing areas for residential use which are likely to be affected by bushfire. While the requirements do not specifically apply to an industrial Project of this nature, the methods provided for calculating APZ's from PBP 2006 have been used as a general guide in this assessment to reassess the risk of bushfire.

Vegetation Formations

Vegetation formations play a key role in bushfire behaviour, woodland and forest vegetation formations represent large fuel loads due to the presence of understory vegetation, leaf litter and for forest vegetation and the connection of the trees within the canopy.

The majority of the active mining areas and associated mining infrastructure is surrounded by cultivated agricultural land and open grassland with pockets of isolated woodland vegetation. The areas of woodland vegetation provide a potential fuel source for bushfire with the surrounding grassland potentially promoting the spread of bushfire across the site.

Slope Analysis

Slope plays an important role in the rate a bushfire can spread. As a bushfire spreads it pre-heats the fuel source through radiation and convection as a consequence of this heat transfer, fire accelerates when travelling uphill and will decelerate when travelling downhill.

With the exception of the steep slopes created by the existing mining operations (tailings dams, waste rock/ore stockpiles, and subsidence/open cut voids) the majority of the Project Area is generally flat to gently undulating, with slopes between 0 and 5 degrees.

Asset Protection Zones

An APZ is a fuel reduced area surrounding a built asset or structure. While PBP 2006 has been developed for residential development, the method provides a suitable guideline for all development, including this Project which may be affected by bushfire.

The required APZ's for grassland and woodland vegetation on slopes of 0 to 5 degrees are 10 and 15 metres respectively. The general layout of the site, including the active mining areas, existing and proposed TSFs and mine access roads create adequate separation distances from the surrounding vegetation ensuring protection from bushfire threat and act as effective firebreaks to prevent bushfires spreading on, from or into the site.

The Project includes the establishment of a new access road to the site which will provide adequate access to the site for fire fighting vehicles with the existing internal access roads providing access across the site.

Majority of the existing infrastructure areas are surrounded by grassland with isolated areas of woodland vegetation with the layout and surrounding access roads providing sufficient separation from surrounding vegetation. The site is predominately surrounded by cultivated agricultural land with minimal areas of vegetation to promote the spread of bushfire into the site.

Ongoing Bushfire Management

As discussed above NPM will continue to implement the bushfire management measures in accordance with its existing Landscape Management Plan to maintain sufficient APZs across the site. Any additional fuel reduction measures required for the site will continue to be assessed and undertaken in consultation with the local NSW Fire Brigade and/or the RFS and will be designed to minimise impacts on biodiversity.

It is considered that bushfire risk can continue to be appropriately managed at the site through the continued effective implementation of the existing bushfire management measures.

5.17 Socio-Economic Assessment

The DGR's require that a social and economic assessment be undertaken for the Project. A detailed Social Impact Assessment (SIA) of the Project was undertaken by Umwelt (refer to **Appendix 15**) with the key findings are outlined in **Section 5.17.1**. A detailed assessment of the potential economic impacts of the Project was undertaken by Gillespie Economics (refer to **Appendix 16**) and the key findings are outlined in **Section 5.17.2**. Both studies have been prepared in accordance with the DGR's for the Project (refer to **Section 1.3**).

The SIA is concerned with assessing the benefits and impacts associated with the Project in non-monetary terms. Whereas, the economic assessment considers the overall benefits and costs of impacts of the Project. For a socio-economic assessment it is important to understand the impacts from the perspectives of those involved in a personal, community, social or cultural sense. Together the SIA and economic assessment processes provide a comprehensive picture of socio-economic impacts of the Project and an understanding of their meaning to the communities connected to the Project.

5.17.1 Social Impact Assessment

SIA aims to predict the future effects of a particular proposal on people. More specifically how the proposal may affect their way of life (how they live, work and interact with each other), their culture (norms and traditions) and their community (institutions and structures) (Armour 1990). It is the role of the social impact assessment to determine positive and negative impacts on the community and aim to ensure that any degree of social disruption is minimised.

5.17.1.1 Methodology

For the SIA there are a variety of ways of involving the community and collecting relevant information to inform the assessment process. The methods utilised as part of the SIA for the Project are summarised in **Table 5.28**.

Table 5.28 – Summary of Social Impact Assessment and Engagement Methods

Method	Description
Documentary analysis	Collation examination and review of relevant reports and studies relating to the Project Area.
Social Indicators Analysis	Examination of census data and other community data sets to develop profiles of relevant townships in the Project Area.
Media Review	Review of local media to identify community issues associated with development and mining in the area generally.
Written Materials	Produced to provide information on the Project, validate issues and summarise assessment results.
Community Meetings	Community meetings include involvement/attendance at Community Consultative Committee (CCC) meetings, local events, Parkes Borefield Committee meetings, Aboriginal heritage working groups. The purpose of community meetings were to provide feedback to the community regarding the outcomes of the studies and to provide an opportunity for stakeholders to discuss specific issues with company representatives and environmental experts, and gain feedback on proposed mitigation and enhancement strategies.
One on One Meetings	One on one meetings were held with key landholders surrounding the Project to provide an overview of the Project, the findings of the EA and to obtain feedback on the Project.

The process has involved a range of stakeholders including local residents/landholders/ tenants, government agencies and service providers. Throughout the EA process, the key aims of the consultation process were to inform stakeholders about the Project, identify any issues of concern or interest to be investigated and addressed, and to provide an opportunity for input into the Project. Key methods of providing Project updates to stakeholders included face to face meetings with neighbours, CCC meetings (bi-annually), provision of written materials (media releases, fact sheets, letters, etc.), and through the NPM website. For more detail on the stakeholder engagement process refer to **Appendix 15**.

5.17.1.2 Community Context

The following section provides an overview of the social context in which the Project is based. The development of this information is based on analysis of relevant census data, time series data (such as employment sectors over time), analysis of local media sources, and a review of other relevant secondary sources.

Population Statistics

In 2011, the Parkes LGA had a population of 15,084 people who live predominantly within the major regional centre of Parkes. Between the 2011 and 2011 Census, the Parkes LGA remained consistent, with a 0.2 per cent increase in population. Population projections for Parkes LGA predict that the population will contract to 14,000 people by 2026; generally occurring in people aged under 54. Unemployment in Parkes LGA, as of September 2012, was at 5.4 per cent and has been consistently higher than the NSW average (DEEWR 2012).

The 2011 Census indicates that Parkes LGA has a lower than average disposable income, with median income for individuals ($456.00), household weekly income ($882.00) and family income ($1131.00) all lower than the NSW values.

As part of the SIA, an Employee and Contractor Survey (ECS) was completed to investigate the interactions of employees and contractors with the local area, with key demographic indicators of the employees and contractors participating in the ECS provided below.

The reported ages of respondents is compared with that of residents within the local area in **Table 5.29**. Note that while there is a higher percent of residents aged 15 to 24 years old in the local area than respondents to the ECS, NPM has no employees under 18 and consequently the result may be skewed towards the census data. Discounting this discrepancy from a wider trend analysis, it can be seen that there are significantly more people aged under 44 at NPM who responded to the ECS than in the general population.

Table 5.29 – NPM Employee and Contractor Ages

Age	Residents in Local Area (%)	ECS Respondents (%)	Difference (%)
15-24 years old*	18.8	14.8	-4.00
25-34 years old	14.6	29.6	15.00
35-44 years old	17.2	33.7	16.50
45-54 years old	19.3	18.5	-0.80
55-64 years old	18.0	2.2	-15.80
65-74 years old	13.9	1.1%	-12.80

Source: Australian Bureau of Statistics (2006).
Note *ECS category 18-24 years old. Based on 15-74 year old population only.

The length of time that respondents to the ECS have been working at NPM is presented in **Table 5.30** and how long respondents (non Fly In Fly Out (FIFO)) have been living in the local area is presented in **Table 5.31**.

Table 5.30 – Length of Time Employed at NPM

Length of Time	Percentage (%)
Less than 1 year	40.7
1-2 years	20.0
2-5 years	14.1
5-10 years	11.9
10-15 years	5.6
Over 15 years	7.8

Table 5.31 – Length of Time Living in Local Area

Length of Time	Parkes (%)	Forbes (%)
Less than 1 year	29.5	11.1
1-2 years	10.6	5.6
2-5 years	12.4	11.1
5-10 years	11.5	16.7
10-20 years	12.4	27.8
More than 20 years	23.5	27.8

Comparison between the length of time living in the local area and the length of time working at NPM indicates that approximately 53 per cent of respondents already lived in the Forbes LGA or Parkes LGA before they began work at NPM, with 23.5 per cent of respondents having lived elsewhere in NSW, 17.4 per cent lived interstate, and 6.1 per cent moved to site from overseas.

The breakdown of property tenures between employees and contractors is given in **Table 5.32**.

Table 5.32 – Property Tenure NPM Employees and Contractors

Property	Employed Directly by Northparkes Mines (%)	Employed Through a Contractor (%)
Have a mortgage	51.4	40.7
Rent	33.5	41.8
Own the home	9.8	6.6
Share house	2.9	3.3
Short term accommodation	1.7	4.4
Other (such as company house, staying with family, etc.)	0.6	3.3

This further supports that the majority of existing employees, and some contractors, are an established part of the local community.

Economic Activity

The economic support of NPM was the most frequently raised topic discussed with the Parkes community during the community consultation (refer to **Section 4.0**). Consultation within Parkes indicated a general understanding that NPM contributed greatly to the local economy, but concern was expressed in regard to what the town would look like if the mine ceased operations.

NPM and its employees contribute many millions of dollars annually to the local economy by expenditure on goods and services. During 2011, NPM paid $34 million in wages, with $27.6 million being paid in the communities of Parkes, Forbes and Peak Hill alone (NPM 2011).

In addition, the presence of NPM employees and contractors within the local area contributes to local economic activity through spending within the local area. The percent of budgeted disposable income spent in the local area for NPM employees who responded to the ECS is presented in **Table 5.33**, and contractors who responded to the ECS in **Table 5.34**. It is noted that due to the limitations of survey methodologies in collecting spending pattern data, the presentation of comparative spending habits is unfeasible. Nonetheless **Table 5.33** and **Table 5.34** provide a reasonable indication of spending habits across NPM employees and contractors.

Table 5.33 – Distribution of NPM Employee Budgeted Spending (Response Count)

Budget	Parkes and Forbes (%)	Dubbo (%)	Orange (%)	Sydney (%)	Other (%)
All of our budget	38	1	0	0	1
Most of our budget	97	0	2	1	3
Half of our budget	19	1	1	0	4
Some of our budget	13	2	7	5	8
A little of our budget	4	37	68	26	24
None of our budget	0	9	2	9	5
Total Responses	171	50	80	41	45

Table 5.34 – Distribution of NPM Contractor Budgeted Spending (Response Count)

Budget	Parkes and Forbes (%)	Dubbo (%)	Orange (%)	Sydney (%)	Other (%)
All of our budget	28	0	0	0	1
Most of our budget	33	3	1	2	9
Half of our budget	9	3	3	1	3
Some of our budget	3	0	4	3	3
A little of our budget	10	12	21	9	1
None of our budget	0	0	0	2	1
Total Responses	83	18	29	17	18

Table 5.33 indicates that 22.2 per cent of NPM employees who responded to the survey spend approximately their entire budget in Parkes and Forbes, and 56.7 per cent of employee respondents spend most of their budget in Parkes and Forbes. **Table 5.34** indicates that 33.7 per cent of contractors who responded to the survey spend approximately their entire budget in Parkes and Forbes, and 39.8 per cent of respondents spend approximately most of the budget in Parkes and Forbes. The 17 per cent difference between NPM employees and contractors in spending most of their budget in Parkes and Forbes is distributed through contractor spending some or a little of their budget in other locations. Other common places where people reported spending their money include Broken Hill, interstate and on the internet. It can be deduced that while some income from employment at NPM or through a contractor to NPM is spent outside the local area, a sizeable portion of employee/contractor income is distributed locally.

5.17.1.3 Community Contributions

In 2012 NPM directly contributed $80,000 in amounts of $1000 to $15,000 to local schools, sporting groups and other community groups.

Some examples of major sponsorship during 2012 include:

- Partnership with CentraCare which produced the ‘Strong Young Mums Program’;
- Creation of a partnership with Forbes Shire Council for a grants officer;
- Establishment of Parkes Aboriginal Project officer position;
- Parkes Life Education Program;
- ‘Read’tember Program with the Parkes Shire Library;
- Continued support of the Parkes Elvis Festival and the Northparkes Street Parade;
- Participation in the Northparkes GP Cup that raised over $25,000;
- Establishment of a partnership with Parkes Hockey;
- Continued support of the Parkes Touch Football Association;
- Support of the construction of the Narromine & Forbes Men’s Sheds;
- Supporting Lachlan Health Services with a Palliative Care Partnership;
- The inaugural November is News’vember initiative; and
- A Peer Tutoring program at Parkes High School.

In addition, NPM employees and contractors are often actively involved in the community, with 81.4 per cent of respondents to the ECS indicating that they were part of a sporting, workers or religious group. 36.8 per cent of respondents had volunteered in the local area within the last 12 months, 19.4 per cent at once off events and 17.5 per cent are regular volunteers.

5.17.1.4 Community Impacts

Socio-economic impacts include demographic changes, such as changes to labour force participation or population changes, and changes to the local or regional economy. They also include changes to demand on social services and infrastructure, and corresponding government expenditure catering for increased (or decreased) demand.

It is proposed that employee numbers will remain consistent with existing operations – generally 350 FTE during normal operations and up to 700 FTE during shut down periods, campaign open cut operations, and/or construction activities. It is noted that 700 FTE is within historic staff levels. As the Project does not propose changes to staff levels, social impacts are likely to be minimal, with negligible significant impacts on employment, community development, housing, childcare, health, education and emergency services in the local area. Additionally, the extension of mine life is considered of benefit to the local community, in regard to providing economic support and employment opportunities for an additional seven years of operational life.

No additional potential for impacts to physical or community infrastructure (including healthcare, education and childcare) were identified through the community consultation process or the SIA. Should unanticipated impacts become evident during the life of the Project (if approved) NPM will liaise with PSC and/or the relevant government body in relation to how infrastructure challenges in the future may be met as a community.

Contractors are likely to be engaged for short term works such as the campaign open cut operations and are likely to require temporary or short term accommodation. Two potential impacts due to the transient nature of the short term increases in employees due to campaign operations, shut down periods and/or construction activities may be temporary increased stress on the rental market, and decreased availability of short term accommodation. Given the size of the proposed campaign, shut down and other extraordinary operations such as construction, and the proven capacity in the rental and short term accommodation markets during the E22 and E48 operations in 2007 to 2008, it is considered that there is sufficient existing and future capacity within the rental and short term accommodation markets to cater for the Project. Nonetheless, noting other influences on the short term accommodation availability such as the Elvis festival, it is recommended that NPM consult with PSC with regard to other influences on accommodation demands when scheduling campaign operations.

Notwithstanding the low potential for significant social impacts associated with the Project, NPM have recently developed a VPA with PSC for the Project. The VPA generally provides for contributions for road upgrades and ongoing maintenance along Bogan Road along with other general contributions.

In addition, FSC have formally resolved to support the Project subject to NPM limiting water extraction to current approved levels. As outlined in **Section 5.8**, water supply levels will be maintained with current approved, and licensed, levels.

5.17.1.5 Mitigation Measures

As there are no significant detrimental socio-economic impacts as a result of the Project, mitigation measures proposed for the Project focus on NPM's ongoing contribution to the local and regional area. These measures include:

- NPM will continue investigating the sizing of contracts in order to facilitate the inclusion of local businesses within ongoing operations.
- NPM will consult with PSC in regard to other influences on accommodation demands when scheduling operations requiring short-term increases in employees and contractors.
- Should unanticipated impacts become evident during the life of the Project, NPM will liaise with PSC and/or the relevant government body in relation to how infrastructure challenges in the future may be met as a community.
- NPM will commence SIA, with regard to mine closure (including consultation with PSC, FSC, and the community), 10 years prior to the anticipated end of mine life, unless further extensions of mine life are being sought at that time.
- NPM will continue its existing community engagement and consultation program and will extend the program to facilitate feedback from the community with regard to community perceptions of NPM in order to proactively manage matters as they arise.

5.17.2 Economic Impact Assessment

The DGR's for the Project (refer to **Section 1.3**) require a detailed assessment economic impacts associated with the Project, including:

- an assessment of the potential direct and indirect economic benefits of the project for local and regional communities and the State; and
- a detailed assessment of the costs and benefits of the of the development as a whole, and whether it would result in a net benefit for the NSW community.

The detailed economic assessment (refer to **Appendix 15**) was prepared in accordance with the DGR's and provides a detailed analysis of the Project in relation to two important aspects, being:

- the economic efficiency of the Project (i.e. consideration of economic costs and benefits of the Project using Benefit Cost Analysis); and
- the economic activity that the Project would provide to the local (Parkes LGA), regional (Parkes and Forbes LGAs) and NSW economy using input-output analysis.

The benefit cost analysis identifies a range of incremental economic benefits and costs of the Project and places indicative values on the production benefits and costs. The economic assessment has not sought to aggregate all economic aspects from NPM operation but rather specifically assesses the additional benefits and costs associated with the Project, primarily relating to additional mining and infrastructure requirements and the proposed extension of mining operations for an additional seven years relative to existing approved operations. External economic benefits and costs of the Project were identified and discussed in detailed in **Appendix 15**. This analysis indicates that the incremental net production benefits of the Project to Australia are $28 million in present values.

The estimated net production benefit of the Project represents the opportunity cost to society of not proceeding with the Project. Put another way, any environmental costs of the Project, after mitigation by NPM, would need to be costed at greater than $28 million to make the Project questionable from an economic efficiency (net community welfare) perspective.

The economic assessment (refer to **Appendix 15**) sought to quantify relevant environmental, cultural and social impacts of the Project. The majority of the costs associated with predicted impacts (including air quality impacts, groundwater, noise impacts, traffic impacts, ecology, surface water (in particular opportunity costs associated with existing licenses), Aboriginal heritage impacts and historic heritage impacts) have been internalised in the calculation of net production value outlined above. The main quantifiable impacts of the Project that have not already been incorporated into the estimate of net production benefits, relate to greenhouse gas emissions. These impacts are estimated at less than $1 million to Australia, considerably less than the estimated net production benefits of the Project.

There may also be some non-market benefits of employment provided by the Project which are estimated to be in the order of $32 million. Overall, the Project is estimated to have net social benefits to Australia of between $28 million and $60 million and hence is desirable and justified from an economic efficiency perspective.

While the BCA is primarily concerned with the aggregate costs and benefits of the Project to Australia, the costs and benefits may be distributed among a number of different stakeholder groups at the local, state, national and global level. The total net production benefit will be distributed amongst a range of stakeholders including:

- NPM shareholders in the form of after tax (and after voluntary contributions) profits.
- The Commonwealth Government in the form of any Company tax payable ($11 million present value) which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local and regional area.
- The NSW Government via royalties ($12 million present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the regional area.
- The local community in the form of any voluntary contributions to community infrastructure and services, as detailed in **Section 5.17.1**.

The economic assessment has also indicated that economic flow on effects from the Project are likely to positively affect and contribute to a range of sectors including metaliferrous mining sector, mining services sector, agricultural and mining machinery manufacturing sector, retail trade sector, wholesale trade sector, wholesale mechanical repairs sector, road transport sector and technical services sector.

An economic impact analysis, using input-output analysis, estimated that the Project would make up to the following total annual contribution to the local economy for the peak years of production:

- $329 million in annual direct and indirect regional output or business turnover;
- $220 million in annual direct and indirect regional value added;
- $34 million in annual direct and indirect household income; and
- 470 direct and indirect jobs.

The Project is estimated to make up to the following total annual contribution to the regional economy for peak years of production:

- $335 million in annual direct and indirect regional output or business turnover;
- $223 million in annual direct and indirect regional value added;
- $39 million in annual direct and indirect household income; and
- 497 direct and indirect jobs.

The regional economic model utilised in the input-output analysis highlighted that the agriculture and mining sectors in the local and regional economy are of greater relative importance than within the overall NSW economy. These characteristics of the local and regional economy confirms the importance of NPM operations within the local area and also emphases the benefits that are associated with the proposed extension of life for an additional seven years to 2032.

The cessation of NPM operations may lead to a reduction in economic activity. The significance of these Project cessation impacts would depend on:

- The degree to which any displaced workers and their families remain within the region, even if they remain unemployed. This is because continued expenditure by these people in the regional economy (even at reduced levels) contributes to final demand.
- The economic structure and trends in the regional economy at the time. For example, if Project cessation takes place in a declining economy the impacts might be felt more greatly than if it takes place in a growing diversified economy.
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

NPM recognise the importance of their operations within the local and regional economy and community, and understand that the cessation of mining operations will affect the local area and region. As outlined in **Section 5.17.1.5**, NPM will commence SIA, with regard to mine closure (including consultation with PSC, FSC, and the community), 10 years prior to the anticipated end of mine life, unless further extensions of mine life are being sought at that time.