05

Risk assessment

5. Risk assessment

5.1 Introduction

This chapter provides a description of the whole-of-project risk assessment undertaken for the identification, assessment and management of project environmental risks associated with the Nolans Project.

The risk assessment provides a framework for identifying components of the project with the potential for greater environmental risk, and highlights areas of focus for environmental impact assessment and project specific control measures to minimise the likelihood and consequence of these identified risks.

Section 5.1 of the TOR for the preparation of an environmental impact assessment issued by the NT EPA for the Nolans Project required a risk assessment process that:

- Identified and discussed a range of risks presented by the project, including relevant potential direct and indirect impacts
- Assessed the risks with regard to their relative ranking to gain an understanding of the potential severity of impact. This ensured the reasons for the associated control measures were apparent
- Assigned levels of certainty about estimates of risk, incorporating consideration of the effectiveness of the planned controls
- Where applicable, recognised members of the community are expected to accept residual risks and their consequences.

This chapter describes the risk assessment methodology, outlines the key outcomes and rankings, and summarises the findings of the risk assessment.

The results of the risk assessment have provided a basis for evaluation and justification of the proposed controls or management measures to modify the risk. The impact pathways and proposed controls have been used to inform the Environmental Management Framework for the project, including the Environmental Management Plan (EMP) and associated sub plans.

5.2 Risk assessment methodology

The risk assessment process has been undertaken using a systematic approach consistent with *AS/NZS ISO 31000:2009 Risk management – Principles and guidelines*, which is schematically presented in Figure 5-1.

The early steps in the process involved establishing the context. Key considerations were setting the boundaries and the scope of the risk assessment, including an initial Project Description (Chapter 3), which formed the basis for the impact and environmental risk assessment.

After the context was established, technical specialists systematically identified potential cause-and-effect ‘pathways’ associated with the project, determining the links between project activities and the potential to impact on a given value or issue.

Once a preliminary risk register was completed by each technical specialist, a risk workshop was held to discuss the full range of risks. This workshop allowed technical specialists from key areas to discuss risks which were interrelated.

A risk assessment for socio-economic risks was completed in a separate risk assessment workshop. This allowed for methodical consideration of the potential social, economic and

heritage impacts of the project, many of which are relatively distinct from other potential environmental impacts.

Risk workshops facilitated independently of the project team were conducted over five days and attended by a cross-section of internal stakeholders and technical specialists.

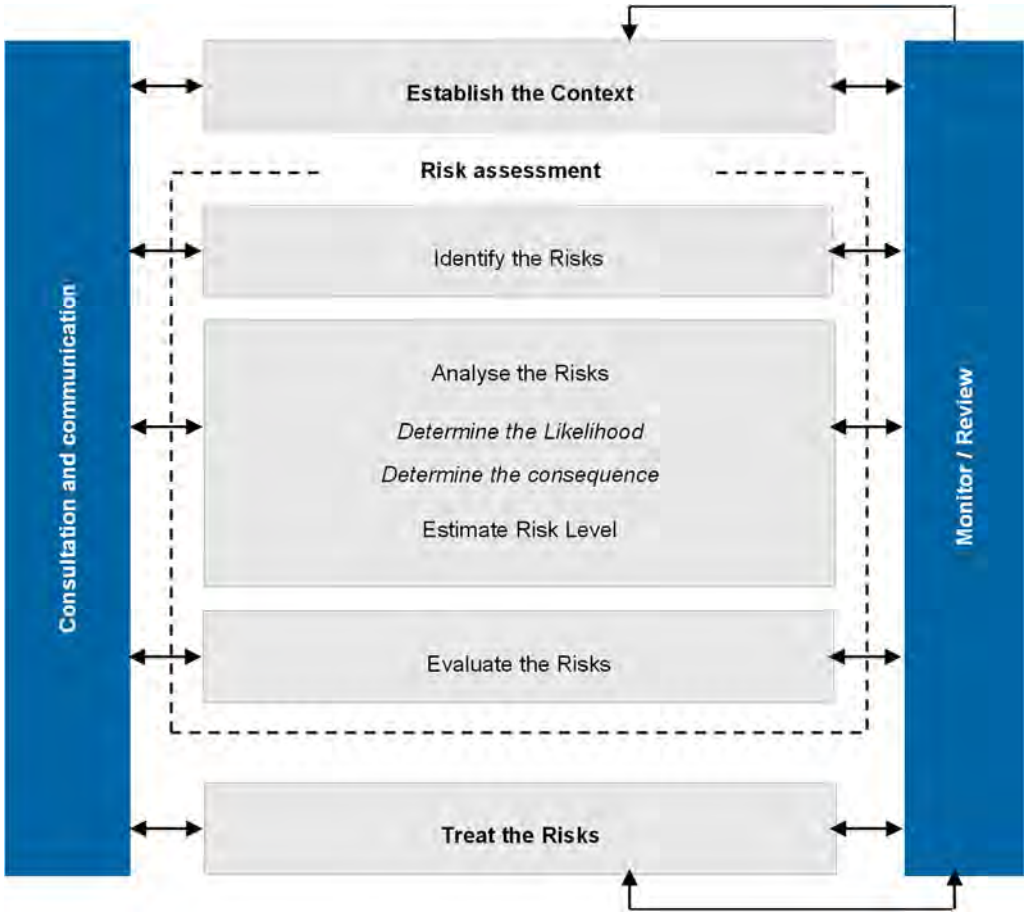

Figure 5-1 Risk management process (AS/NZS ISO 31000:2009)

5.2.1 Context establishment

The scope of the risk assessment included construction and operation, decommissioning, closure and post-closure risks of the project in relation to environmental, social and economic values on both a local and regional scale. An initial project description along with existing condition reports was used as a basis for the risk assessments. The project description provided details of the project footprint, project infrastructure requirements as well as construction and operational activities and processes. The project description also established the base level of planned controls that are inherent in the project design.

5.2.2 Risk identification

To determine risks, it is necessary to identify and describe cause and effect pathways for the project. Impact pathways identify the activity or event associated with project phases, and give consideration to assets, values and uses. This was done systematically for each discipline area to determine links between project activities and their subsequent consequences. The list of identified risks was developed using knowledge of the specific activities proposed for each component of the project across the phases, the local environmental context and understanding of the potential environmental or socio-economic impacts.

The risk assessment for socio-economic impacts identified both the negative impacts and positive opportunities that may accrue from the project, in order to minimise the socio-economic

costs and maximise the benefits. This approach is in line with NT EPA *Guidelines for the Preparation of an Economic and Social Impact Assessment.*

5.2.3 Risk analysis and evaluation

Risk ratings were established for each pathway by technical specialists assigning a level of consequence in accordance with consequence criteria for the project (Table 5-1) and a level of likelihood in accordance with likelihood descriptors (Table 5-2).

Consequence criteria range on a scale of magnitude from 'insignificant' to 'catastrophic'. Magnitude was considered as a function of the size of the impact, the spatial area affected and expected recovery time. These were influenced by the requirements of relevant legislation and guidelines.

Some risk events can have consequences on multiple environmental receptors. To provide a meaningful and manageable risk register, these potential impacts were grouped as a risk event with each potential impact assessed separately.

The initial risk rating considered the consequence and likelihood of the risk event with planned controls in place. These controls are consistent with the project description, regulatory requirements and management measures for projects of this nature (refer to the EMP contained in Appendix X).

Risks were assessed considering the maximum credible consequence level. Combining the assessed level of consequence and the likelihood of that consequence occurring provides guidance on the risk rating (Table 5-3). The risk was then assessed against relevant criteria as shown in Table 5-4 to determine if additional actions are required to be taken, or if the risk is at a tolerable level.

In addition to the risk ratings, the assessment applied a certainty level to each overall risk rating based on the information and data available, as listed in Table 5-5. The certainty assessment incorporated consideration of the effectiveness of the planned controls to manage the risk and was able to be used to assist in determining if further actions should be focused on in order to manage risks.

5.2.4 Risk treatment

Where practicable, additional control measures were developed to further reduce the risk. In the case of the social risk assessment where the impacts are positive in nature, the risk treatment included actions to optimise or enhance these benefits for local and regional communities.

The risk was reassessed with planned and additional controls in place to confirm the effect of the additional control measures. This second rating is known as the residual risk rating.

The control measures have been used in developing the EMP (Appendix X) and associated monitoring programs, where applicable. The controls are actions to be implemented in the delivery of the project through the construction, operation, decommissioning, closure and post-closure phases.

5.3 Risk register

A risk register was established to document the findings of the risk assessment process, presented separately for environmental and socio-economic risks. The risk register contains details of impact pathways, their consequences, planned controls inherent in the project description, an initial risk assessment, additional controls, and the residual risk rating. These are presented in Appendix F (environmental) and Appendix G (social).

Table 5-1 Project consequence descriptors

Aspect	Insignificant	Minor	Moderate	Major	Catastrophic
Air quality	No measurable air quality impacts or exceedance of air quality standards	Local, short-term, and approaching exceedance of air quality standards	Local, minor, long-term, or widespread minor short-term or exceedance of air quality standards	Widespread (regional), major, short-term exceedance of air quality standards	Regional long term change in air quality or exceedance of air quality standards
Biodiversity: Listed flora species	Minor local habitat modification and/or lifecycle disruption for a listed species	Moderate local habitat modification and/or lifecycle disruption for a listed species	Substantial local habitat modification and/or lifecycle disruption for a listed species	Moderate regional habitat modification and/or lifecycle disruption for a listed species	Substantial regional habitat modification and/or lifecycle disruption for a listed species
Biodiversity: Listed threatened fauna species	No loss of individuals of listed fauna species	Minor local decrease in size of population(s) of listed fauna species	Moderate local decrease in size of population(s) of listed fauna species	Substantial local decrease in size of population(s) of listed fauna species	Moderate or substantial regional decrease in size of population(s) of listed fauna species
Biodiversity: General flora and fauna	Insignificant or imperceptible effects	Local short term decrease in abundance of some species with no lasting effects on local population	Local long term decrease in abundance of some species resulting in some change to community structure	Regional decrease in abundance of some species resulting in some changes to community structure	Regional loss of numerous species resulting in the dominance of a few species
Historic and cultural heritage: Aboriginal and cultural heritage	Minor repairable damage to common structures or sites. No disturbance of historic and / or cultural heritage sites	Moderate or repairable damage or infringement to sensitive structures or sites of cultural significance or sacred value	Considerable damage or infringement to sensitive structures or sites of cultural significance or sacred value	Major damage or infringement to sensitive structures or sites of cultural significance or sacred value	Irreparable and permanent damage to sensitive structures or sites of cultural significance or sacred value
Human health and safety: Safety	Low level short term subjective inconvenience or symptoms. Typically first aid and no medical treatment.	Reversible / minor injuries requiring medical treatment, but does not lead to restricted duties. Typically a medical treatment.	Reversible injury or moderate irreversible damage or impairment to one or more persons. Typically a lost time injury.	Single fatality and/or severe irreversible damage or severe impairment to one or more persons.	Multiple fatalities or permanent damage to multiple people.

Aspect	Insignificant	Minor	Moderate	Major	Catastrophic
Human health and safety: Health	Reversible health effects of little concern, requiring first aid treatment at most.	Reversible health effects of concern that would typically result in medical treatment.	Severe, reversible health effects of concern that would typically result in a lost time illness.	Single fatality or irreversible health effects or disabling illness.	Multiple fatalities or serious disabling illness to multiple people.
Radiation: Occupational exposure	<1 mSv/y. Measurable increase in radiation dose with outcomes below public dose limit.	<5 mSv/y. Measurable increase in radiation dose with outcomes remaining below dose constraints.	>5 mSv/y and <20 mSv/y. Measurable increase in radiation dose with outcomes between action level and dose limit (average over five year period).	>20 mSv/y and <50 mSv/y. Measurable increase in radiation dose with outcomes between dose limit (average over five year period) and maximum annual dose.	>50 mSv/y. Measurable increase in radiation dose with outcomes greater than the maximum annual dose.
Radiation: Public exposure	No change from background. Dose not discernible above natural background.	<0.3 mSv/y. Measurable increase in radiation dose with outcomes below public dose constraint.	>0.3 mSv/y and <1 mSv/y. Measurable increase in radiation dose with outcomes between dose constraint and dose limit (averaged over five years) for public.	>1 mSv/y and <5 mSv/y. Measurable increase in radiation dose with outcomes between dose limit (averaged over five years) and maximum annual dose for public.	>5 mSv/y. Measurable increase in radiation dose with outcomes greater than the maximum annual dose for public.
Radiation: Environmental impact	ERICA* RQ < 0.1	ERICA RQ >0.1 and <1.0	ERICA RQ >1.0 plus justification	ERICA RQ >1.0 and no justification	ERICA RQ > 10.0
Socio-economic: Community	Local, small-scale, easily reversible change on social characteristics or values of the communities of interest or communities can easily adapt or cope with change.	Short-term recoverable changes to social characteristics and values of the communities of interest or community has substantial capacity to adapt and cope with change.	Medium-term recoverable changes to social characteristics and values of the communities of interest or community has some capacity to adapt and cope with change.	Long-term recoverable changes to social characteristics and values of the communities of interest or community has limited capacity to adapt and cope with change.	Irreversible changes to social characteristics and values of the communities of interest or community has no capacity to adapt and cope with change.

Aspect	Insignificant	Minor	Moderate	Major	Catastrophic
Transport: Traffic and transport operations and conditions	Negligible adverse impact on traffic and transport conditions. No perceptible deterioration of road integrity.	Detectable adverse changes in traffic and transport condition (decrease in Level of Service) at one or two locations at any one point in time during the construction period or at a single location during operations. Seasonal, local deterioration of road integrity.	Detectable adverse change in traffic and transport conditions (decrease in Level of Service) at multiple locations. Short-term, local deterioration of road integrity.	Traffic and transport congestion and delays exceed acceptable levels at multiple locations. Short-term, regional deterioration of road integrity.	Traffic and transport congestion and delays severely restrict the safe operation and efficiency of the transport network. Long-term, regional deterioration of road integrity.
Transport: Road safety on public roads	No increase in vehicle incidents along relevant haulage routes above historical baseline trend.	An increase in vehicle incidents along relevant haulage routes of five per cent above historical baseline trend.	An increase in vehicle incidents along relevant haulage routes of ten per cent above historical baseline trend.	An increase in vehicle incidents along relevant haulage routes of twenty per cent above historical baseline trend.	An increase in vehicle incidents along relevant haulage routes of greater than twenty per cent above historical baseline trend.
Water: Surface water	Minimal contamination or change with no significant loss of quality.	Local minor short term reduction or change in water quality. Local contamination or change that can be immediately remediated.	Local minor long term or widespread minor short term or local major short term reduction or change in water quality. Local contamination or change that can be remediated in long term.	Widespread (regional) major short term reduction or change in water quality. Local contamination or change that cannot be remediated in long term. Widespread contamination or change that can be remediated.	Regional long term reduction or change in water quality. Widespread contamination or change that cannot be immediately remediated.
Water: Groundwater	Negligible change to groundwater regime, quality and availability.	Changes to groundwater regime, quality and availability but no significant implications.	Changes to groundwater regime, quality and availability with minor groundwater implications for a localised area.	Groundwater regime, quality or availability significantly compromised.	Widespread groundwater resource depletion, contamination or subsidence.

* Note ERICA is tool for the assessment of impacts of radiation on non-human biota where RQ is the risk quotient value.

Table 5-2 Project likelihood descriptors

Descriptor	Explanation
Almost Certain	The event is expected to occur in most circumstances. This event could occur at least once during a project of this nature 91-100% chance of occurring during the project.
Likely	The event will probably occur in most circumstances. This event could occur up to once during a project of this nature 51-90% chance of occurring during the project.
Possible	The event could occur but not expected. This event could occur up to once every 10 projects of this nature 11-50% chance of occurring during the project.
Unlikely	The event could occur but is improbable. This event could occur up to once every 10-100 projects of this nature 1-10% chance of occurring during the project.
Rare	The event may occur only in exceptional circumstances. This event is not expected to occur except under exceptional circumstances (up to once every 100 projects of this nature). Less than 1% chance of occurring during the project.

Table 5-3 Project risk matrix

	Consequence				
Likelihood	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost Certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	High
Unlikely	Low	Low	Medium	Medium	High
Rare	Low	Low	Low	Medium	Medium

Table 5-4 Risk criteria

Rating	Approach
Extreme	Intolerable – Risk reduction is mandatory wherever practicable. Residual risk can only be accepted if endorsed by senior management.
High	Intolerable or tolerable if managed to as low as reasonably practicable – Senior management accountability.
Medium	Intolerable or tolerable if managed to as low as reasonably practicable – Management responsibility.
Low	Tolerable – Maintain systematic controls and monitor.

Table 5-5 Project data availability descriptors

Descriptor	Explanation
Low Level	Risk rating is based on subjective opinion or relevant past experience.
Medium Level	Risk rating is based on similar conditions being observed previously and/or qualitative analysis.
High Level	Risk rating is based on testing, modelling or simulation, use of prototype or experiments. Analysis is based on verified models and/or data. Assessment is based on an historical basis.

5.4 Discussion of key outcomes

5.4.1 Risk assessment results

The environmental risk assessment identified 81 risk events, of which several had potential impacts on multiple environmental receptors. As a result, 135 impact pathways were identified and assessed through the environmental risk assessment process.

The separate social risk assessment identified and assessed 22 socio-economic risk events, of which 18 were potential negative impacts and four were potential positive impacts. Table 5-6 reflects only negative impacts, and its total of 20 socio-economic risk events includes two community risks and the 18 negative socio-economic risks from the social risk register.

The residual risk rating for most risks was rated as Low (Figure 5-2). Those rated Medium or High were the subject of particular attention in the development of further control measures and management plans.

The risk profile across the study area is presented in Table 5-6 and Figure 5-3, which highlight the distribution of project risks per environmental aspect. This shows that the highest number of risks is associated with Human Health and Safety followed closely by Fauna and Socio Economics. There were no risks identified and assessed with an Extreme risk rating.

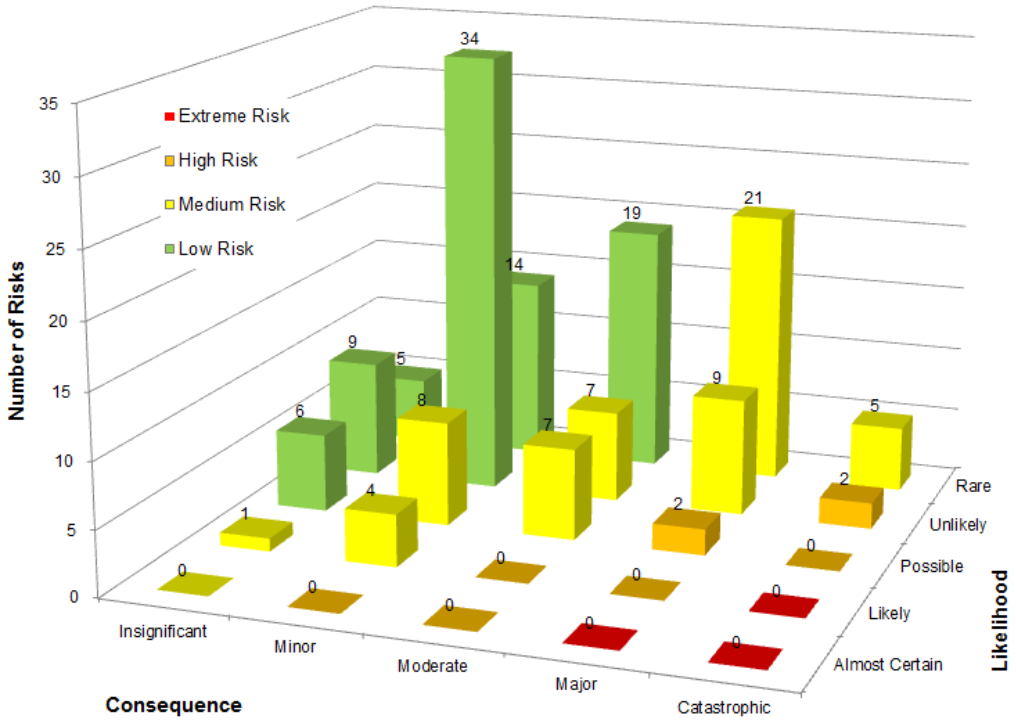

Figure 5-2 Whole-of-project residual risk ratings

Table 5-6 Summary of residual risk ratings by study area

Study Area	Low	Medium	High	Extreme	Total
Air quality	5	2	0	0	7
Socio-economic	12	7	1	0	20
Fauna	16	5	0	0	21
Flora	13	4	0	0	17
Groundwater	10	7	0	0	17
Historic and cultural heritage	4	1	0	0	5
Human health and safety	0	23	2	0	25
Mine closure	4	4	0	0	8
Radiation	12	2	0	0	14
Surface water	11	4	0	0	15
Transport	2	2	0	0	4
Total	89	61	3	0	153

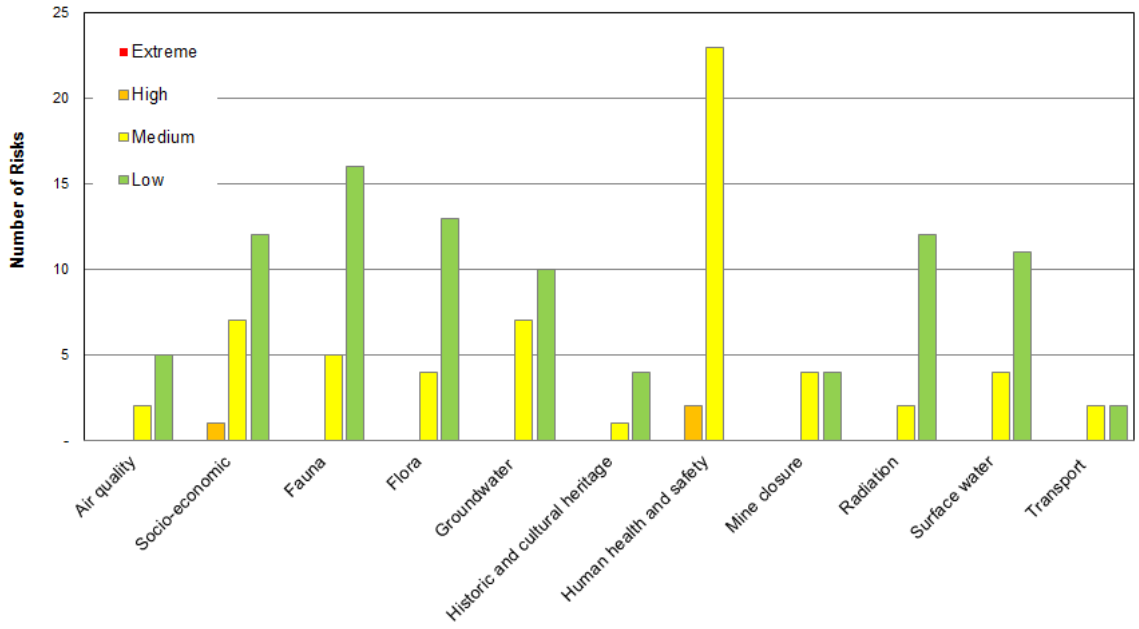

Figure 5-3 Distribution of residual risk ratings by study area

Key risk areas that were subject to further detailed impact assessment and risk management planning include the following:

- Health and safety of project personnel from interaction with equipment as well as mobile and fixed plant, during construction and operation activities
- Dust fallout and deposition, including impacts to fauna and nearby sensitive receptors, from wind erosion of exposed surfaces and vehicle movement along haul roads
- Flora, vegetation communities and fauna habitat impact from spread of weeds and feral animals due to vehicle movements and/or inappropriate waste management
- Groundwater quality from seepage, embankment failure or overtopping of tailings, residue storage facilities and/or process liquor evaporation ponds
- Decline in availability of water to existing and/or future users, within the Southern basin from progressive water table drawdown arising from groundwater extraction rates
- Social and family tensions from increased disposable income and distribution of benefits payments in the local communities
- Employment impacts to existing local businesses (e.g. retail, hospitality, council) due to recruitment of project personnel
- Wellbeing of project personnel due to living away from home and lack of family / support networks.

After the application of additional control measures, the residual risk profile changes slightly from Figure 5-3 to that presented in Figure 5-4. It demonstrates that:

- The majority of risks are unlikely or may occur only in exceptional circumstances
- The maximum credible consequence of most risks is no greater than a minor impact.

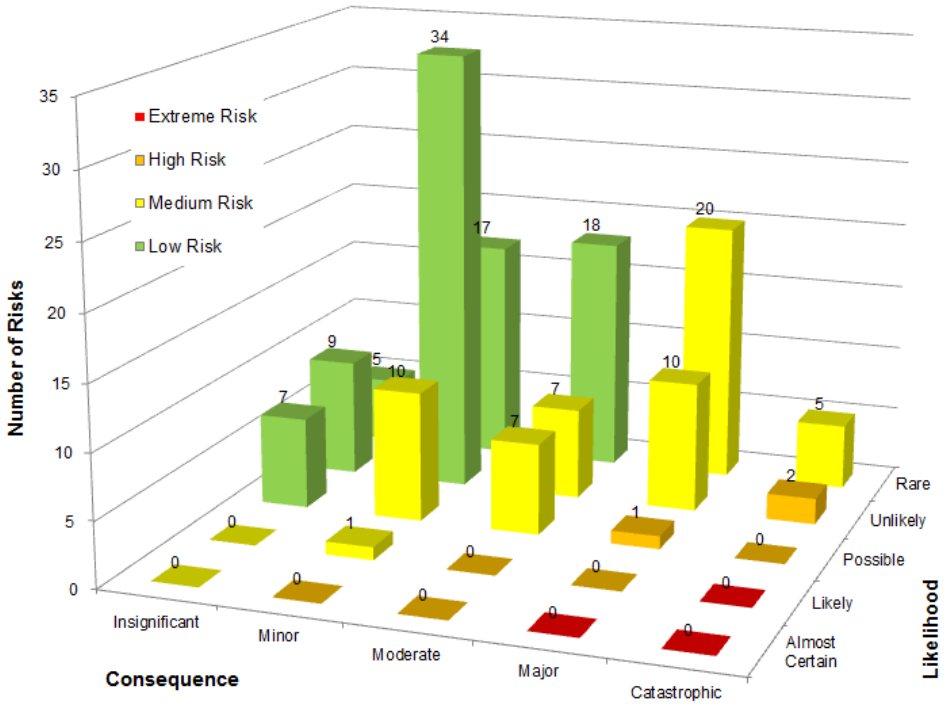

Figure 5-4 Whole-of-project residual risk ratings after additional control measures

There are however, a range of medium level risks which will be actively managed through identified control measures. No risk was assessed as having an initial or residual risk rating of extreme. The top three risks have a residual risk rating of high, and have been acknowledged as key areas for management:

1. Vehicle incident associated with the transport of materials and personnel off-site on public roads
2. Mobile equipment incident on site, including all operational areas and vehicle types
3. Project personnel mental health issues, including potential for self-harm, associated with or exacerbated by living away from home and lack of family / support networks.

5.4.2 Key control measures

Key controls for the management of identified risks are covered in the EMP (Appendix X) for the project, which encompasses the following sub plans:

- Air and Dust Management Plan
- Biodiversity Management Plan
- Cultural Heritage Management Plan
- Emergency Response Plan
- Fire Management Plan
- Hazardous Substances Management Plan
- Mine Closure Plan
- Non-mineralised Waste Management Plan

- Acid Metalliferous Drainage Management Plan
- Water Management Plan
- Erosion and Sediment Control Plan
- Weed Management Plan and
- Social Impact Management Plan.

5.5 Conclusion

A risk based approach was adopted to identify and assess potential impacts associated with the project, in terms of their credible worst case consequence and the likelihood of that consequence occurring.

The risk assessment was conservative in approach, to provide reputable results. A summary was developed of the findings that describe the activities of the project and the prioritisation of the associated risks. The results of the risk assessment have been reported in the individual impact assessment report for each specialist study area, providing justification for the rating and outlining additional control measures to manage the risk.

The risk identification and additional control measures have been used to inform the Environmental Management Framework for the project, and in particular the aspects in the EMP and associated sub plans.