

Appendix R

Mine development preliminary hazard analysis



LFB Resources Ltd (NL)

McPhillamys Preliminary Hazard Analysis

<i>Prepared for:</i>	LFB Resources NL, McPhillamys Gold Project
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**LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis**

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- AS/NZ ISO 31000:2018 *Risk Management – Principles and Guidelines* (Standards Australia, 2009);
 - HB 203:2006 *Environmental Risk Management – Principles and Process* (Standards Australia, 2006);
 - NSW Department of Planning Publications:
 - HODA Guidelines – Applying SEPP 33, 2011
 - Assessment Guideline – Multi Level Risk Analysis 201
 - HIPAP No 3 Risk Assessment 2011
 - HIPAP No 6 Hazard Analysis 2011

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29 June 2019

LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis

TABLE OF CONTENTS

1	INTRODUCTION	4
1.1	OVERVIEW	4
1.2	PROJECT OVERVIEW	4
1.3	ASSESSMENT REQUIREMENTS	8
2	RISK ANALYSIS.....	10
2.1	CLARIFYING POINTS	10
2.2	HAZARD ASSESSMENT PROCESS	10
2.3	RESOURCING, SCHEDULE AND ACCOUNTABILITIES.....	10
2.4	METHODOLOGY	12
2.4.1	<i>Framework</i>	<i>12</i>
2.4.2	<i>Key Steps</i>	<i>12</i>
2.4.3	<i>External Facilitation</i>	<i>13</i>
3	ESTABLISH THE CONTEXT.....	13
3.1	PROJECT SUMMARY	13
3.2	RISK MANAGEMENT CONTEXT	13
3.3	PRELIMINARY SCREENING.....	13
3.4	RISK CRITERIA	17
4	RISK CLASSIFICATION AND PRIORITISATION.....	18
4.1	OVERVIEW	18
4.2	PRELIMINARY HAZARD ANALYSIS TEAM	18
4.3	RISK IDENTIFICATION	19
4.3.1	<i>Inventory Analysis</i>	<i>19</i>
4.3.2	<i>Preliminary Screening – Worst Case Considerations.....</i>	<i>20</i>
4.3.3	<i>Preliminary Screening – Off-Site Transport.....</i>	<i>22</i>
5	RISK ANALYSIS AND ASSESSMENT	24
5.1	PROBABILITY AND MAXIMUM REASONABLE CONSEQUENCE	24
5.2	RISK RANKING.....	25
6	MONITOR AND REVIEW.....	28
6.1	NOMINATED CO-ORDINATOR.....	28
6.2	COMMUNICATION AND CONSULTATION.....	28
6.3	CONCLUDING REMARKS	29
7	ATTACHMENT A – DEFINITIONS.....	30

LFB Resources NL McPhillamys Gold Project **Preliminary Hazard Analysis** ---

List of Figures

FIGURE 1.1	PROJECT APPLICATION AREA – REGIONAL SETTING	6
FIGURE 3	- RISK MANAGEMENT PROCESS (AS/NZS ISO 31000:2018)	11
FIGURE 4	– HIPAP 6 BASIC METHODOLOGY FOR HAZARD ANALYSIS	11
FIGURE 5	- RISK CRITERIA "ALARP"	18
FIGURE 6	– WORST CASE HCN PLUME	21
FIGURE 7	– IMPACTS OF A LPG TANK FAILURE AND FIRE.....	22

List of Tables

TABLE 1	TECHNICAL ASSESSMENT FOR PHA RELATED EARS AND AGENCY REQUIREMENTS.....	9
TABLE 2	– SEPP 33 RISK SCREEN SUMMARY – STORAGE	15
TABLE 3	– TRANSPORTED REAGENTS.....	23
TABLE 4	– QUALITATIVE MEASURES OF PROBABILITY	24
TABLE 5	– QUALITATIVE MEASURES OF MAXIMUM REASONABLE CONSEQUENCE.....	24
TABLE 6	– RISK RANKING TABLE	25
TABLE 7	– RISK RANKING RESULTS	26

1 INTRODUCTION

1.1 OVERVIEW

LFB Resources NL is seeking development consent for the construction and operation of the McPhillamys Gold Project (the project), a greenfield open cut gold mine and water supply pipeline in the Central West of New South Wales (NSW) approximately 8 km north-east of Blayney, within the Blayney and Cabonne local government areas (LGAs). The project application area is illustrated at a regional scale in Figure 1.1.

As shown in Figure 1.1, the McPhillamys Gold Project comprises two key components; the mine site where the ore will be extracted, processed and gold produced for distribution to the market (the mine development), and an associated water pipeline which will enable the supply of water from approximately 90 km away near Lithgow to the mine site (the pipeline development).

This report represents a Preliminary Hazard Analysis (PHA) for the mine development component of the McPhillamys Gold Project prepared in accordance with *Applying SEPP 33 - Hazardous and Offensive Development Application Guidelines*, (DoP 2011). References to 'the project' throughout this report are therefore referring to the mine development only. A PHA has not been prepared for the pipeline development as the minor quantities of hazardous goods associated with the construction of the pipeline do not exceed the Preliminary Risk Screening Assessment thresholds (DoP 2011). The potential hazards and risks associated with the pipeline development component are addressed in the main report of the Environmental Impact Statement (EIS) (Volume 1, EMM 2019a).

LFB Resources NL is a 100% owned subsidiary of Regis Resources Limited (referred herein as Regis). The mine development project boundary (referred herein as the project area) is illustrated in Figure 1.2.

The purpose of the PHA is to assess whether the project represents offensive or hazardous development, as defined by *State Environmental Planning Policy No 33 – Hazardous and Offensive Development* (SEPP 33) thereby posing an unacceptable risk to the surrounding land uses.

This PHA report forms part of the EIS. It documents the assessment methods, results and the considerations given to measures built into the project design to avoid and minimise impacts to people, property and the environment, and identify any areas of additional study to confirm that executed operational management plans will help to avoid these types of risks arising from the project.

1.2 PROJECT OVERVIEW

A full project description is provided in Chapter 2 of the EIS (EMM 2019). The key components of the project are as follows:

- Development and operation of an open cut gold mine, comprising approximately one to two years of construction, approximately 10 years of mining and processing and a closure period (including the final rehabilitation phase) of approximately three to four years, noting there may be some overlap of these phases. The total project life for which approval is sought is 15 years.
- Development and operation of a single circular open cut mine with a diameter of approximately 1,050 metres (m) and a final depth of approximately 460 m, developed by conventional open cut mining methods encompassing drill, blast, load and haul operations. Up to 8.5 Million tonnes per annum (Mtpa) of ore will be extracted during the project life.
- Construction and use of a conventional carbon-in-leach processing facility with an approximate processing rate of 7Mtpa to produce approximately 200,000 ounces per annum of product gold. The processing facility will comprise a run-of-mine (ROM) pad and crushing, grinding, gravity, leaching, gold recovery, tailings thickening, cyanide destruction and tailings management circuits. Product gold will be taken off-site to customers via road transport.

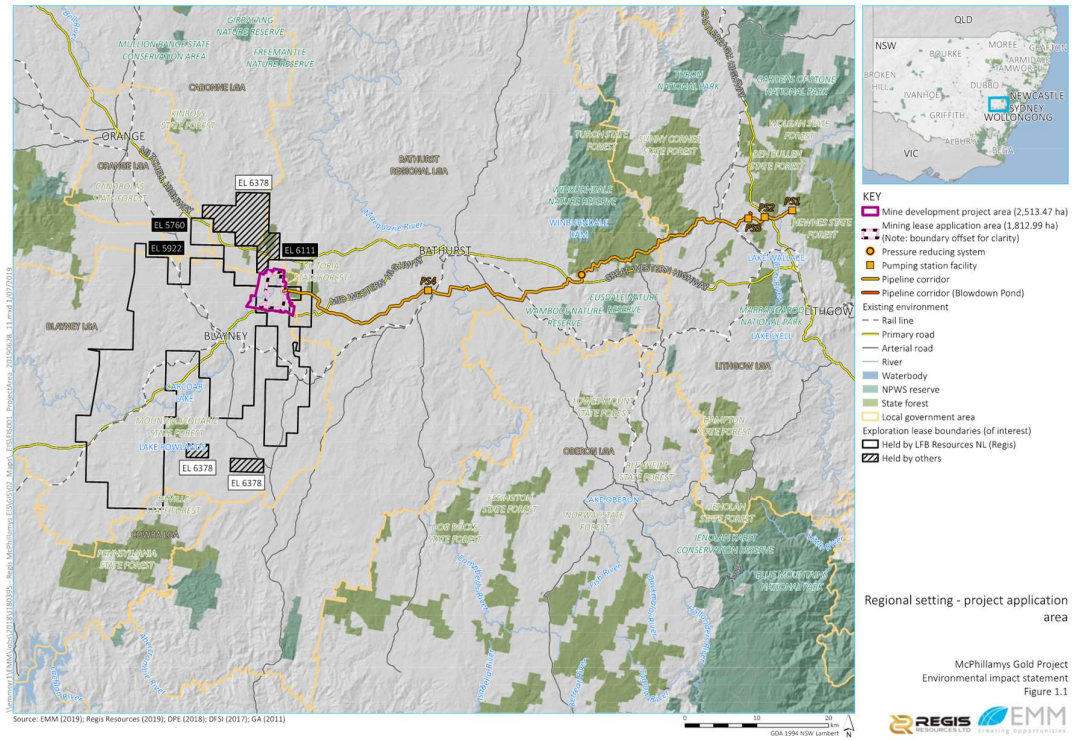
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Preliminary Hazard Analysis

- Placement of waste rock into a waste rock emplacement which will include encapsulation of material with the potential to produce a low pH leachate. A portion of the waste rock emplacement will be constructed and rehabilitated early in the project to act as an amenity bund.
- Construction and use of an engineered tailings storage facility to store tailings material.
- Construction and operation of associated mine infrastructure including:
 - administration buildings and bathhouse;
 - workshop and stores facilities, including associated plant parking, laydown and hardstand areas, vehicle washdown facilities, and fuel and lubricant storage;
 - internal road network;
 - explosives magazine and ammonium nitrate emulsion storage facilities;
 - topsoil, subsoil and capping stockpiles;
 - ancillary facilities, including fences, access roads, car parking areas and communications infrastructure; and
 - on-site laboratory.
- Establishment and use of a site access road and intersection with the Mid Western Highway.
- Construction and operation of water management infrastructure, including water storages, clean water and process water diversions and sediment control infrastructure.
- A peak construction workforce of approximately 710 full-time equivalent (FTE) workers. During operations, an average workforce of around 260 FTE employees will be required, peaking at approximately 320 FTEs in around years four and five of the project.
- Construction and operation of a water supply pipeline approximately 90 km long from Centennial's Angus Place and SCSO; and EA's MPPS operations near Lithgow to the mine project area. The pipeline development will include approximately 4 pumping station facilities, a pressure reducing system and communication system. Approximately 13 ML/day (up to a maximum of 16 ML/day) will be transferred for mining and processing operations.
- Environmental management and monitoring equipment.

Progressive rehabilitation throughout the mine life. At the end of mining, mine infrastructure will be decommissioned, and disturbed areas will be rehabilitated to integrate with natural landforms as far as practicable consistent with relevant land use strategies of the relevant local government areas (LGAs).

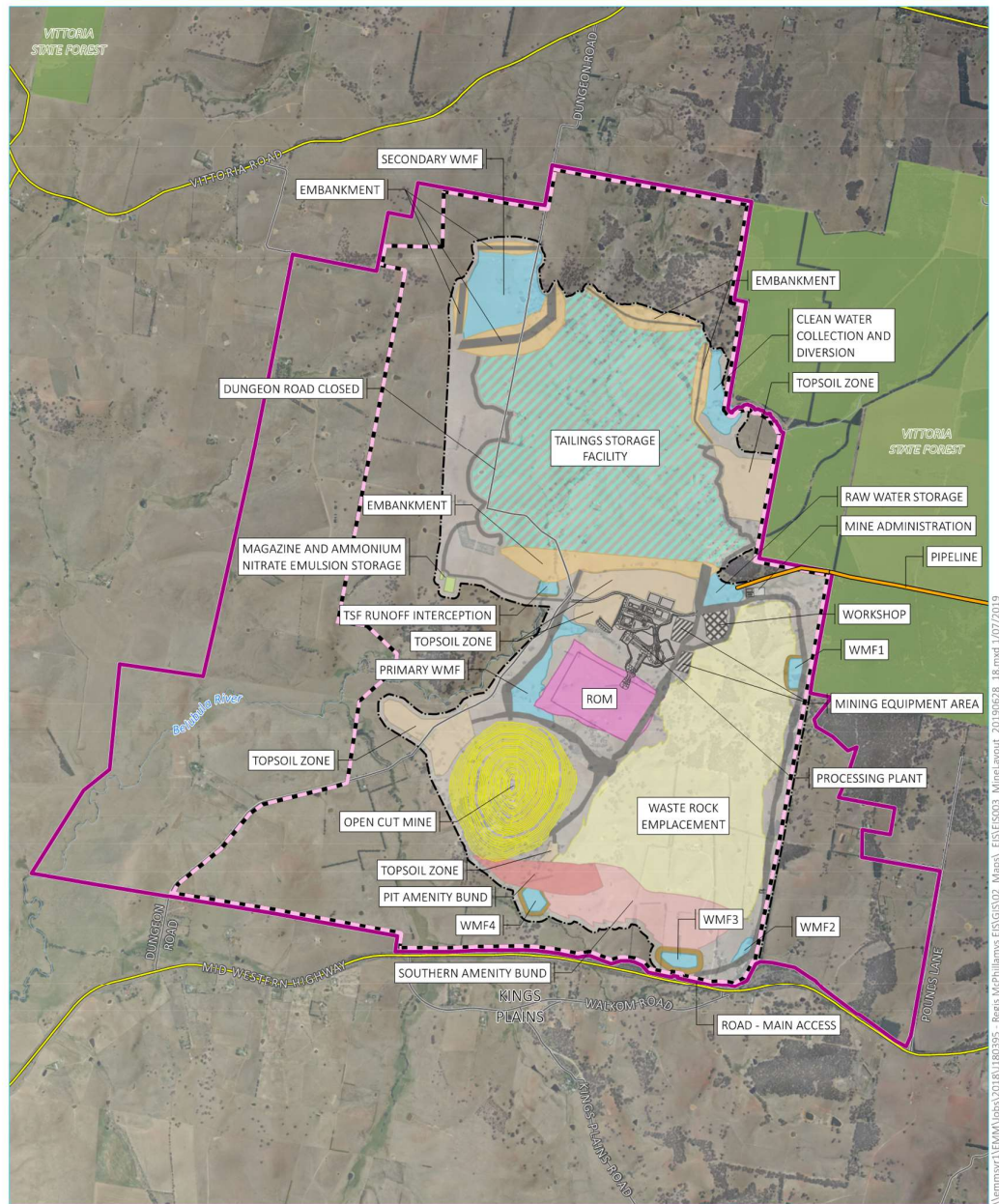
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Figure 1.1 Project Application Area – Regional Setting



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Figure 1.2 Project Area



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DPE (2018); DFSI (2017); GA (2011)

0 1 2 km
GDA 1994 MGA Zone 55

KEY

- | | |
|---|---------------------------------|
| Project application area | Road |
| Mine development project area (2,513.47 ha) | Water management facility (WMF) |
| Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity) | Sediment basin structure |
| Disturbance footprint | Existing environment |
| Pipeline corridor | Main road |
| Project general arrangement | Local road |
| Plant layout | Belubula River |
| | State forest |

Mine development general arrangement

McPhillamys Gold Project
Environmental impact statement
Figure 2.1



1.3 ASSESSMENT REQUIREMENTS

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33) requires the consent authority to consider a project's potential to cause hazards or be offensive, including consideration of the location of the development and the way in which it is to be carried out. Where SEPP 33 identifies a development as potentially hazardous and/or offensive, proponents are required to undertake a PHA to determine the level of risk to people, property and the environment at the proposed location and in the presence of controls.

This PHA has been prepared following the appropriate guidelines, policies and industry requirements, and following consultation with stakeholders including community members and relevant government agencies.

Guidelines and policies referenced are as follows:

- AS/NZ ISO 31000:2018 *Risk Management – Principles and Guidelines* (Standards Australia, 2009);
- HB 203:2006 *Environmental Risk Management – Principles and Process* (Standards Australia, 2006);
- MDG1010 Minerals Industry Safety and Health Risk Management Guideline (Department of Trade and Investment, 2011);
- NSW Department of Planning (DoP) now Department of Planning and Environment (DPE), publications:
 - Hazardous and Offensive Development Application Guidelines – Applying SEPP 33, 2011
 - Assessment Guideline – Multi Level Risk Analysis 2011
 - Hazardous Industries Planning Advisory Paper No 3 Risk Assessment 2011
 - Hazardous Industries Planning Advisory Paper No 6 Hazard Analysis 2011

This assessment has also been prepared in accordance with requirements of the NSW DPE. These were set out in DPE's Environmental Assessment Requirements (EARs) for the Project, issued on 24 July 2018 and revised on 19 December 2018. The EARs identify matters which must be addressed in the EIS and essentially form its terms of reference. To inform the preparation of the EARs, DPE invited other government agencies to recommend matters to be address in the EIS. These matters were taken into account by the Secretary for DPE when preparing the EARs. Copies of the government agencies' advice to DPE were attached to the EARs. NSW Roads and Maritime Services (RMS) raised matters relevant to this Preliminary Hazard Analysis. Table 1 lists individual requirements relevant to this Preliminary Hazard Analysis and where they are addressed in this report.

LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis

Table 1 Technical assessment for PHA related EARs and agency requirements

Author	Stated Requirement	How Addressed in this Document
NSW Dept of Planning and Environment	Hazards - including an assessment of the likely risks to public safety, paying particular attention to potential geochemical and bushfire risks, and storage, handling, transport and use of any dangerous goods	Storage, handling, transport and use of any dangerous goods have been considered and included in this report. Issues related to geochemical issues and bushfire risks are addressed in other elements of the EIS ¹ .
Roads and Maritime Services	An assessment of the likely risks to public safety, in particular, transport and use of any dangerous goods, and in accordance with State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33) and transporting reagents in accordance with the requirements of Australian Dangerous Goods Code and Australian Standard 4452 Storage and Handling of Toxic Substances.	Site and transport threats related to use of Dangerous Goods are covered in this report and a conformance cross map to SEPP 33 requirements is provided.

¹ Bushfire and geochemical risks are addressed in Chapter 18 of the project EIS (EMM 2019).

2 RISK ANALYSIS

The scope of the Preliminary Hazard Analysis workshop was to:

In accordance with SEPP 33 and relevant guidelines to identify the potential hazards related to the McPhillamys Gold Project and to assess whether the project is offensive or hazardous development as defined by SEPP 33 and thereby pose an unacceptable risk to the surrounding community.

2.1 CLARIFYING POINTS

The following clarifying points regarding the scope were made:

- Geographical extent was limited to the project area apart from off-site transport.
- Off-site transport of hazardous materials including cyanide and explosives to the mine site was also considered in this work. The PHA considered risk to people, property and the environment associated with the transportation of hazardous materials to the site to determine whether this constituted a potentially hazardous development.

2.2 HAZARD ASSESSMENT PROCESS

The hazard assessment process was based on the framework provided in Figure 2 (based on AS/NZS ISO 31000:2018, MDG1010 *Minerals Industry Safety and Health Risk Management Guideline* [NSW Department of Trade and Investment, 2011] and HB 203:2006 *Environmental Risk Management – Principles and Process* [HB 2003:2006]). Further, the analysis took method input from the NSW Department of Planning and Industry's guidance material – Multi-level Risk Assessment, HIPAP 3

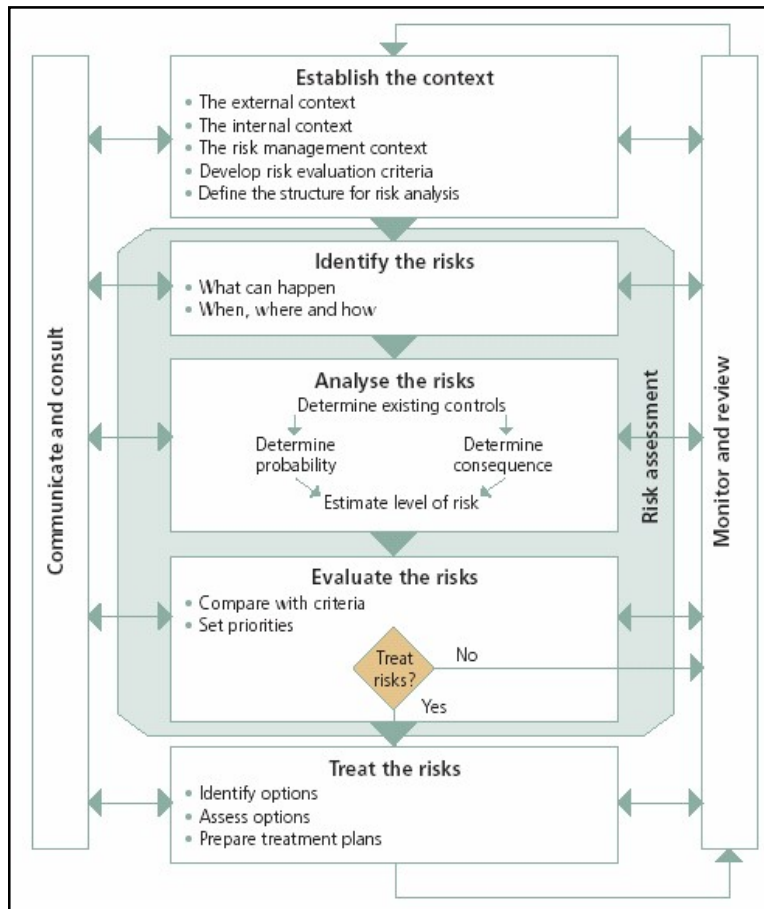
2.3 RESOURCING, SCHEDULE AND ACCOUNTABILITIES

The following resources were allocated in order to effectively conduct the PHA:

1. a team of personnel with suitable experience and knowledge of mining operations, hazardous substances required and environmental issues in the area associated with the Project;
2. a team of subject matter experts available to review the online version of the modified report;
3. external facilitators for the hazard analysis and write-up of results; and
4. aerial photographs, drawings, the relevant agency's assessment requirements and various technical reports provided for consideration by the team.

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Preliminary Hazard Analysis**

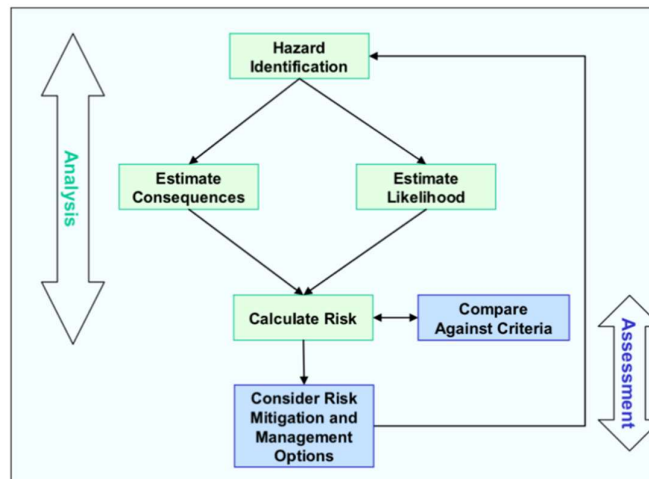
Figure 2 - Risk Management Process (AS/NZS ISO 31000:2018)



Source: after AS/NZS ISO 31000:2018.

Note that this process is closely aligned with the process identified in HIPAP 6 (Figure 2 on page 5 of HIPAP 6) and shown as Figure 3 below.

Figure 3 – HIPAP 6 Basic Methodology for Hazard Analysis



LFB Resources NL McPhillamys Gold Project

Preliminary Hazard Analysis

The outcomes of the PHA and associated accountabilities were understood by the team as intended to be integrated into the EIS and overall Regis management systems so that they are effectively reviewed, implemented and monitored.

2.4 METHODOLOGY

2.4.1 Framework

Figure 2 and Figure 3 outline the overall framework utilised for the PHA. This was further informed by the Assessment Guideline for Multi-level Risk Assessment (DoP 2011) at page vii which identifies three key phases:

1. Preliminary Screening – determine whether the project represents a potentially hazardous or offensive development, thereby requiring the preparation of a PHA by applying qualitative considerations to identify plausible loss scenarios²;
2. Risk classification and prioritisation – considering the nature of the loss scenarios for off-site impact;
3. Risk Analysis and assessment – making an assessment of risk level (against NSW DPE guidelines) and using this to trigger an appropriate methodology to apply (i.e. qualitative, partial quantification or a full quantitative analysis).

2.4.2 Key Steps

The key steps in the process included:

1. confirming the scope of the study;
2. listing any identified assumptions on which the study is based;
3. reviewing available data on the project including reports, plans, maps and aerial photos (both prior to and during the workshop);
4. conduct a team-based risk assessment that:
 - a) Drew on the knowledge base of the team members to identify issues to consider;
 - b) Identified hazards and plausible loss scenarios then assessed the level of risk; and
 - c) Considered these issues in the light of NSW Government guidance material as to whether a more rigorous phase of study was required (i.e. if a Major Hazardous Facility consideration was required);
5. reviewing documentation and presentations by Regis personnel on the intended project design features;
6. preparing a draft report in accordance with AS/NZS ISO 31000:2018 and MDG1010 *Minerals Industry Safety and Health Risk Management Guideline* (Department of Trade and Investment, 2011) for review by Regis personnel and PHA team members;
7. incorporate comments from Regis and the assessment team; and
8. finalise the report and issue as controlled copy for ongoing use.

² Plausible loss scenarios are those incident types that are filtered to simplify the required combination of inputs. The intent here is to avoid directing resources towards losses that are at some level possible but which require a long sequence of concurrent rare events or conditions to be in place for the incident to occur. For example, sabotage leading to initiation of explosives at the cyanide compound is a loss scenario which would be barely plausible given the multiple layers of engineering and administrative controls in place.

LFB Resources NL McPhillamys Gold Project

Preliminary Hazard Analysis

With respect to the overall framework (Figure 2), steps 1 to 3 above represent the 'establish the context' phase and step 4 represents the 'identify risks', 'analyse risks', 'evaluate risks' and 'treat risks' phases.

As described in Section 2.2, the outcomes of the PHA and associated accountabilities will be integrated into the EIS and overall Regis management systems so that they are effectively reviewed, implemented and monitored.

2.4.3 External Facilitation

The team was facilitated through the process by **Risk Mentor** – a company specialising in Risk Assessment and strategic risk management programmes. The facilitator, Dr Peter Standish, is experienced with open cut gold mining and many aspects of environmental monitoring and rehabilitation.

The team was encouraged and "challenged" to identify a wide range of environmental impacts or hazards.

It is important to understand that the outcomes of this analysis:

1. are process driven;
2. challenge current thinking and may not necessarily appear appropriate or reflect "pre-conceived" ideas; and
3. are the result of the team assembled to review the topic and not the result of any one individual or organisation.

3 ESTABLISH THE CONTEXT

3.1 PROJECT SUMMARY

The main activities associated with the development of the Project are described earlier in this report and more thoroughly in Chapter 2 of the EIS (EMM 2019).

3.2 RISK MANAGEMENT CONTEXT

This PHA has been conducted in accordance with *Applying SEPP 33* (DoP 2011). In addition, the PHA was prepared cognisant of the following documents:

- AS/NZ ISO 31000:2018;
- Multi-Level Risk Assessment Guideline (DoP 2004), and HIPAP No 6 on Hazard Analysis (DoP 2011);
- HB 203:2006 Handbook on Risk Management; and
- MDG1010 *Minerals Industry Safety and Health Risk Management Guideline* (Department of Trade and Investment, 2011).

3.3 PRELIMINARY SCREENING

A review of the McPhillamys Gold Project identified a number of dangerous goods that would be required to be managed as part of construction and operation of the project. The team identified the following:

- Explosives for mining (stored in purpose built and standards conforming containers, magazines and compounds):
 - 1,000 tonnes of pre-cursors (i.e. Ammonium Nitrate or similar)
 - 20 tonnes of boosters (mid-strength / high VOD explosives)
 - 10 tonnes of detonators
- Products used for recovering gold from the ore stream in the processing plant:
 - Quicklime (pH increaser) in a 200 tonne tank;

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Preliminary Hazard Analysis

- Sodium Cyanide – 33 tonnes bulk storage and 300m³ tanked for distribution around the plant via protected pipelines;
- Sodium Hydroxide – 55m³ for improving recovery and raising pH of solutions;
- Hydrochloric Acid – 60m³ for pre-elution treatment of the activated carbon (i.e. recovery of gold);
- SMBS – Sodium Meta Bi Sulphate – 140m³ for cyanide detoxification;
- Copper Sulphate – 45m³ in solution and 27 tonnes stored on site;
- General goods for use in multiple locations:
 - Diesel – 240 tonnes;
 - Oil & Lubricants – 20 tonnes;
 - LPG – 2 x 7 tonne “bullets”

A number of the dangerous goods to be managed and used as part of the project exceed threshold volumes/quantities specified in Applying SEPP 33. Output from this process is presented in Table 2 and Table 3 below. Based on the type and quantity of hazardous goods associated with the project, a decision was made to move to the phase of completing a PHA to support the EIS.

With the exception of explosives, cyanide and LPG - all of the goods on the site could be very effectively constrained to prevent any hazardous conditions arising beyond the immediate storage/usage location. Further, those goods which could generate vapour/mist/fume/blast overpressure would be remote from the disturbance boundaries and even further from members of the public.

All liquid dangerous goods loss scenarios were identified as being fully contained in the compliant vessels, bunds, compounds and catchment structures intended to be constructed as part of the project.

**LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis**

Table 2 – SEPP 33 Risk Screen Summary – Storage

Material/Usage	DG Class	Category	Project Storage (tonnes)	SEPP 33 Threshold (tonnes)	Exceed Threshold?
Quicklime	8	Miscellaneous dangerous good	200	8 (Tbl 3)	Yes
Sodium Cyanide	6.1	Toxic Dangerous good	33	2.5 (Tbl 3)	Yes
Sodium Hydroxide	8	Miscellaneous dangerous good	20	8 (Tbl 3)	Yes
Hydrochloric Acid	8	Miscellaneous dangerous good	30	8 (Tbl 3)	Yes
LPG	2.1	Flammable gas	14	10 (Tbl 3)	Yes
Sodium Metabisulphite	9	Miscellaneous dangerous good	70	N/A	No
Copper Sulphate	9	Miscellaneous dangerous good	27	N/A	No
Explosives	1.1	Explosive	30	30 tonne at 400 metres (Fig 6)	No
Diesel	3	Flammable Liquid	240	300 tonne at 20 metres (Fig 8)	No
Oil and Lubricants	3	Flammable Liquid	20	20 tonnes at 7 metres (Fig 6)	No

**LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis**

Table 3 – SEPP 33 Risk Screening Summary – Transport³

Material/Usage	DG Class	Category	Vehicle Movements		Minimum quantity per load (tonne)		Exceed Threshold?
			Annual	Peak Weekly	Bulk	Packaged	
Liquefied Petroleum Gas (LPG)	2.1	Flammable gas	>30	>3	7	-	Not exceeded. Movement will occur in line with any applied conditions (time and route)
Sodium Cyanide	6.1	Toxic Dangerous Good	>40	>3	-	20	Yes. Movements will occur in line with the Australian Dangerous Goods Transport Code
Sodium Hydroxide	8	Misc DG	>30	>3	-	20	Yes. Movements will occur in line with the Australian Dangerous Goods Transport Code
Hydrochloric Acid	8	Misc DG	>20	>2	20	-	Yes. Movements will occur in line with the Australian Dangerous Goods Transport Code
Quicklime	8	Misc DG	>20	>2	20	-	Yes. Movements will occur in line with the Australian Dangerous Goods Transport Code
Sodium Metabisulphite	9	Misc DG	>20	>2	-	20	Not exceeded. Movement will occur in line with any applied conditions (time and route)
Copper Sulphate	9	Misc DG	>20	>2	-	20	Not exceeded. Movement will occur in line with any applied conditions (time and route)
Explosives	1.1	Explosive	>50	>5	-	10	Yes. Explosives will be delivered in 33t b double loads averaging approximately 237 times per year. Movements will occur in line with the Australian Dangerous Goods Transport Code
Diesel Fuel	3	Flammable Liquid	>50	>5	20	-	Yes. Diesel will be delivered in 39t b double loads (approximately 46,000 litres) approximately 401 times per year. Movements will occur in line with the Australian Dangerous Goods Transport Code
Oils and Lubricants	3	Flammable Liquid	>40	>3	-	10	Yes. Movements will occur in line with the Australian Dangerous Goods Transport Code

³ From Table 2 in the NSW Government Applying SEPP 33 guideline, January 2011, pg 18.

LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis

3.4 RISK CRITERIA

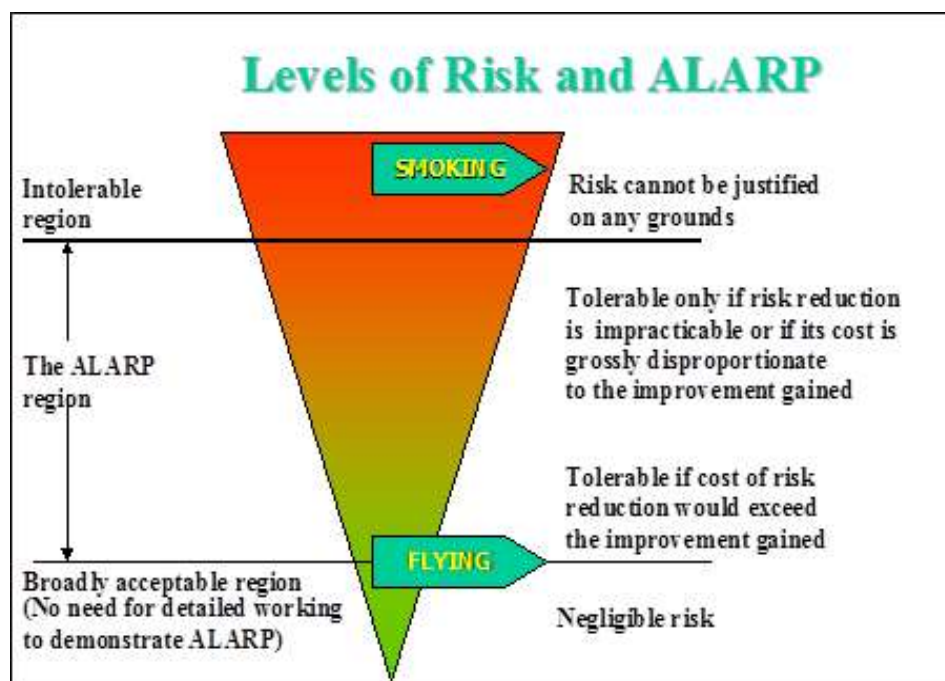
The risk criteria utilised is to reduce the risk to As Low As Reasonably Practicable (ALARP) or lower. Guidance in HIPAP 4 – Risk Criteria for Land Use Safety Planning provides some additional guidance on qualitative risk criteria. This study is qualitative in nature – and these measures are applied as shown in the table below.

Table 4 – Qualitative Risk Criteria at the Project

Criteria (HIPAP 4 pg 6)	Comment/How Applied in this PHA
(a) All avoidable risks should be avoided.	Not broadly applied (as this PHA is applied to risks present in the project) – although the author notes that a range of project options were assessed during the pre-feasibility study phase and some options were rejected on the basis of posing a risk that could be avoided.
(b) Risk from a major hazard should be reduced wherever practicable – regardless of the “total risk” of the project.	All identified materials and processes with major hazard potential are considered in this PHA and the intended risk reduction measures are summarised and discussed. It is also noted that this study has relied on a consequence modelling approach. In this case the credible frequencies are not included – even though they are likely to be low – as the identified worst case consequences were all in the tolerable range.
(c) The consequences (effects) of the more likely hazardous events should... be contained within the boundaries of the installation.	The preliminary screening sections (above) have demonstrated that for worst case loss scenarios there is a very low potential for harm to occur outside the project disturbance boundary.
(d) Where there is an existing high risk from a hazardous installation, additional hazardous developments should not be allowed if they add significantly to that existing risk.	There are no hazardous installations proximate to the project – so this has not been analysed in this PHA.

Figure 4 below schematically shows the three risk management zones viz. intolerable, ALARP and tolerable. The middle zone is referred to as the ALARP zone. HIPAP 4 provides some additional information on the quantitative risk levels that align with these zones. The broadly acceptable zone is any risk which can be determined as being less than 1 in 1,000,000 (1×10^{-6}) – and the top end for tolerability is 50 in 1,000,000 (5×10^{-5}). These values are intended for use when conducting quantitative risk analyses (not intended in this report on the back of the Preliminary Screening (see above).

Figure 4 - Risk Criteria "ALARP"



Flying is an example of a risk considered by most people to be a tolerable risk; whilst smoking is generally considered to be an activity which cannot be justified from a risk perspective. This is shown graphically in Figure 4. Intolerable items such as smoking are at the top of the pyramid where much lower risks, such as flying, sit at the lower end of the ALARP zone (close to tolerable).

The risk ranking matrices used during the PHA workshop are presented in Section 5 later in this report.

4 RISK CLASSIFICATION AND PRIORITISATION

4.1 OVERVIEW

The identification of risks involved the use of risk assessment "tools" appropriate for identifying potential loss scenarios associated with the Project. The tools used were:

- Introduction – before the potential issues were brainstormed it was important that the whole team had a good understanding of the Project, and this was confirmed by the facilitator.
- Inventory analysis – considering the various dangerous/hazardous goods required for the project and the likely storage and transport volumes of these – and using this as an input to generation of loss scenarios that could impact off site people, fauna and features.

4.2 PRELIMINARY HAZARD ANALYSIS TEAM

The review team met across two locations on the 5th and 6th of February, 2019. A team based approach was utilised in order to have an appropriate mix of skills and experience to identify the potential loss scenarios from a variety of perspectives. Details of the team members and their relevant qualifications and experience are included in Table 5 below.

**LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis**

Table 5 – Team Information

Name	Role / Affiliation	Experience, Training and Skills I bring to the team session
Tom Ridges	NSW Senior Exploration Geologist LFB Resources NL	B Sc (Geol). Masters in Mineral Economics. Over 13 years industrial experience
Paul Thomas	Chief Operating Officer - LFB Resources NL	B Eng (Extractive Met). Over 25 years industrial experience
Andrew Wannan	Approvals Manager - LFB Resources NL	B Town Planning. Over 35 years industrial experience
Frank Botica	McPhillamys Study Manager LFB Resources NL	B Business, Project Development experience for over 20 years
Phil Gunn	Senior Project Engineer - LFB Resources NL	B Eng (Elec). M BA, Engineering Manager Cadia and Newcrest and over 30 years industrial experience
Wade Stephenson	General Manager Project Development Mining LFB Resources NL	B Eng (Mine) and over 30 years industrial experience
Chris Roach	NFB Resources NL Community Superintendent	Over 25 years industrial experience and community liaison practice
Mat Lyons	LFB Resources NL Environmental Superintendent (WA and NSW)	B Sc (Environmental Management), 10 years experience in industrial operations
Drew Noble	Group Metallurgist	B Eng (Extractive Met). Over 20 years industrial experience
Nicole Armit	Project Director, EMM, Environmental Scientist	B Eng, M En, B Law and over 19 years industrial and environmental approvals experience
Sarah Parfett	LFB Resources NL, Admin, Health and Safety Officer	Cert IV WHS and over 7 years exploration experience. Local landholder (>20 year Blayney resident).
Tony McPaul	LFB Resources NL, Manager Special Projects	Over 35 years mining industry experience
Stacey McFawn	LFB Resources NL, Site Administrator	Cert IV FLM, Advanced Diploma in Rural Business Admin, mining certificates and over 15 years industrial experience
Rod Smith	LFB Resources NL, General Manager NSW	B Sc (Met), over 35 years industrial experience - operational and consulting
Janet Krick	EMM Consulting Senior Environmental Planner - EIS	B.DevS, Grad Dip Natural Resources, Grad Cert Enviro Mangt. 12 years Environmental Approvals experience.
Peter Standish	Facilitator / OpRM	Formal mining qualifications (PhD, B.Eng), statutory manager qualifications and over 25 years industrial experience. Facilitator for over 30 environmental and approval risk analyses

4.3 RISK IDENTIFICATION

4.3.1 Inventory Analysis

A range of Dangerous/Hazardous Chemicals are required for the effective operation of the project. The team drew on the current designs and their operating experience to generate the following listing for further consideration:

- Quicklime - 200 tonnes (stored in a purpose built steel bin).
- Sodium Cyanide - 33 tonne (maximum stored quantity of Flexible Intermediate Bulk Containers (FIBCs) prior to mixing) + 300m³ liquid (in tanks and pipework).

LFB Resources NL McPhillamys Gold Project

Preliminary Hazard Analysis

- Sodium Hydroxide - 55 m³ (arrives in solid form and is mixed and stored in tanks and pipework).
- Hydrochloric Acid - 60 m³ (stored in tanks and pipework).
- LPG - 2 x 7 tonne bullets.
- SMBS (Sodium Metabisulphite) - 140 m³ (in tanks and pipework) plus 73 tonnes in purpose built, compliant packaging.
- Copper Sulphate - 45 m³ (in tanks and pipework) plus 27 tonnes in purpose built, compliant packaging.
- Explosives - 1,000 tonnes of precursors- 20 tonnes Booster plus 10 tonnes detonators in purpose built, compliant and approved magazines and (as appropriate) compliant packaging.
- Diesel - 240 tonne in tanks.
- Oil and lubricants - 20 tonne in a combination of tanks and compliant packaging.

Each of these substances was used as a trigger/prompt term – and led to the development of the loss scenarios presented in Table 7 later in this report.

4.3.2 Preliminary Screening – Worst Case Considerations

Worst Case as defined in Section 7 later in this document is the considered scenario which could arise if all available energies were to be released in a single event/incident.

4.3.2.1 Preliminary Screening – Worst Case - Explosives

The magazine location is over 2,200 metres from the nearest non-company residence (R76) and over 1,000 metres to the nearest offices on the site. At the closer range the complete deflagration of all the explosives stored (30 tonnes) at the magazine would lead to a low order over-pressure that was unlikely to cause any injuries (based on the US Centre for Disease Control (CDC) guidelines paper Explosions and Refuge Chambers by R. Karl Zipf, Jr., Ph.D., P.E. and Kenneth L. Cashdollar). The peak overpressure calculated using a Kingery-Bulmash method (as provided by the United Nations SaferGuard series on International Ammunitions) is 3.6 kPa – well under the lowest value of 6.9 kPa shown in the CDC guidance materials which could cause minor injury.

This analysis is extremely conservative as it does not take into consideration the very robust magazine structures designed to minimise potential for unwanted initiation of explosives, effects of preferential failure pathways of these structures (all designed to release pressure vertically) or the presence of the earthen bunds which will further serve to deflect blast over-pressure and debris away from potential receivers. Explosives management practices, applied by Regis at their existing mine sites (in Western Australia) are intended to be adopted at the project. These measures successfully prevent any unwanted explosives initiation and have posed no risk to members of the public.

On this basis, the presence of explosives on site can be considered to constitute no credible threat to public safety off site and no further risk based study is recommended at this stage of the project.

4.3.2.2 Preliminary Screening – Worst Case – Hydrogen Cyanide

Sodium Cyanide is transported to site as a solid (cyanoid) in purpose built Isotainers or Flexible Intermediate Bulk Containers (FIBCs) and stored in these containers in a dry, bunded and locked compound until deployed for use. The design of the storage compound meets the requirements of the International Cyanide Code and to this end is in an isolated location, remote from flammable materials and where any spillage (to 110% of the total stored) is contained in a purpose built bunded area. No plausible means of igniting and heating the solid NaCN cyanoids identified – which indicates there is no credible fume release of any appreciable percentage of the 33 tonnes intended for storage.

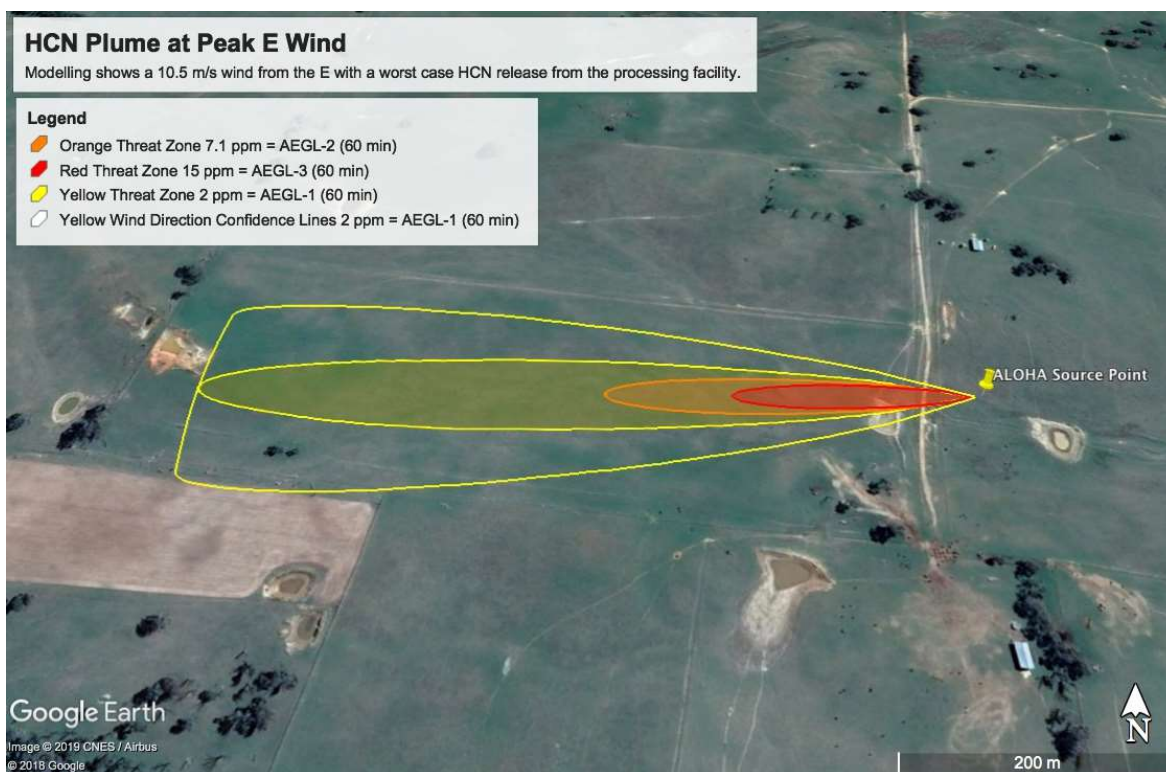
There is some 300 m³ of liquid in the processing circuit – but this is almost universally contained in enclosed tanks or rated and labelled pipelines. Dosing points typically discharge at rates in the order of litres per minute and would not be able to generate the substantial quantities of CN fume required to cause a release outside of the disturbance area of the site.

LFB Resources NL McPhillamys Gold Project

Preliminary Hazard Analysis

One (barely) plausible loss scenario would be the release of HCN if an acid, rather than a caustic, solution was held in the mixing tank for the circuit. Normal practice is for a strongly alkaline solution to be used (leading to minimal HCN vapour pressure over the surface of the tank). If maintainers re-routed the acid and caustic lines to this tank⁴ then a low pH solution would be present. Taken to its logical conclusion – the 1 tonne of NaCN transferred from the FIBC to the mixing tank would begin to generate HCN (and consequently trigger the site Cyanide alarm and associated emergency response). If all recovery controls failed a total of some 600 kg of HCN would be released. Normal times for complete mixing of the cyanoids is in the order of 3 to 4 hours. Assuming a more rapid reaction time of 1 hour – this allows for a plume model to be applied. This HCN plume, which will issue from the top of the tank, will disperse in line with the prevailing wind conditions. The dominant Easterly wind direction would lead to a worst-case loss scenario as shown in Figure 5 below. The complete extent of this plume is contained within the disturbance area and so cannot pose any threat to members of the public.

Figure 5 – Worst Case HCN Plume



Cyanide (and other reagent) management practices, applied by Regis at their existing mine sites (in Western Australia) are intended to be adopted at the project. These measures successfully prevent any unwanted releases or reactions and have posed no risk to members of the public.

No further risk based analysis of this loss scenario is suggested at this stage of the project.

⁴ This scenario was worked up as it couldn't be completely ruled out. It should be noted that the two lines (acid and caustic) are intended to be plumbed very distant from each other around the plant (the caustic is at the feed end and the acid at the product end) in completely different sized and coloured lines with clear labelling of the line contents. The resulting low pH solution in the tank would act to provide an environment where a high vapour pressure of HCN would arise.

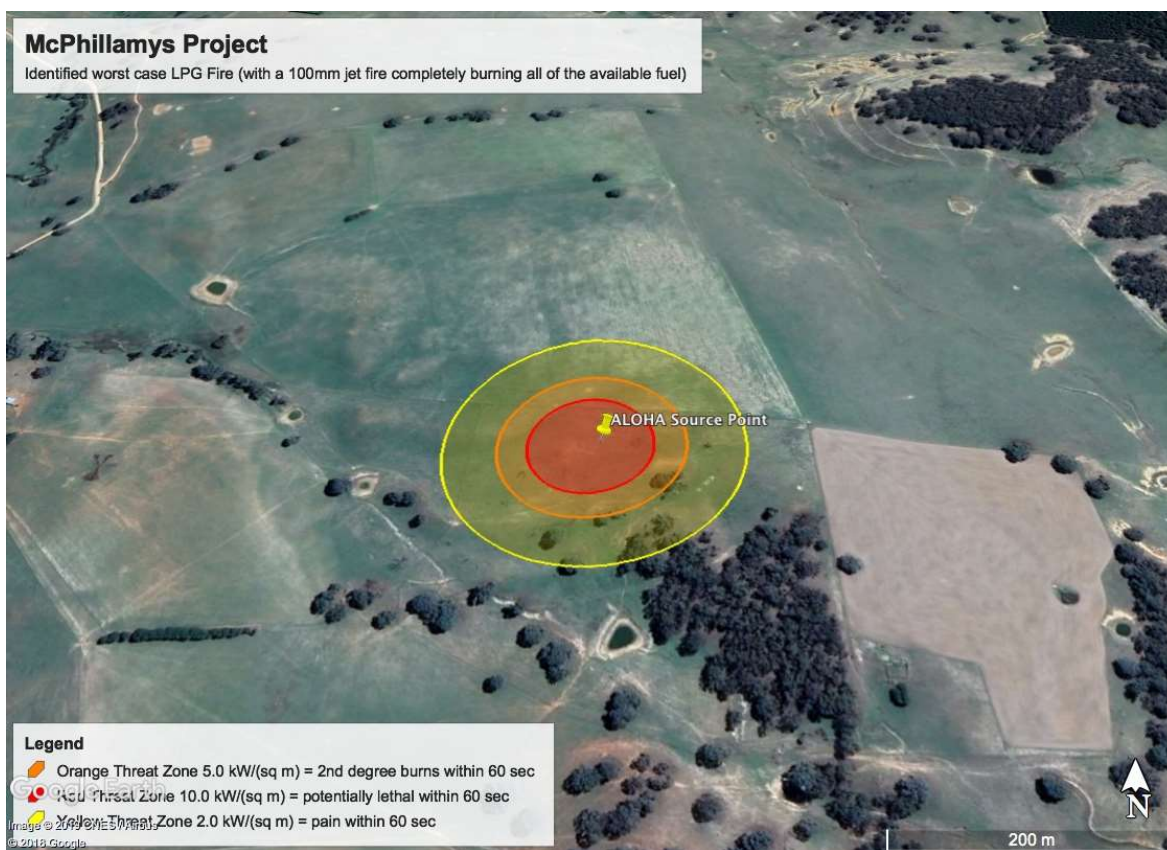
LFB Resources NL McPhillamys Gold Project

Preliminary Hazard Analysis

4.3.2.3 Preliminary Screening – Worst Case – On Site Fire of Stored Flammable Goods

The project will require diesel and LP Gas to be able to be constructed and to operate. The quantities intended to be used are up to 240 tonnes of Diesel and 14 tonnes of LPG. A tank fire of LPG would generate the most severe fire event – and an analysis of a ruptured tank shows an impact of less than 200 metres (which based on the standards is 2.0 kW/m^2 which is the point at which pain could be experienced within 60 seconds). A diesel fire would last for a longer period – but be of a lesser intensity and has not been modelled. The diesel and LPG storage locations are remote from each other and are intended to be maintained to prevent unwanted interaction with mobile equipment and other ignition sources and build up of fuel (e.g. vegetation near storages). General management of fuels and flammable materials will occur in line with Regis procedures adapted to meet site requirements for prevention of fire and harm to people and natural environment.

Figure 6 – Impacts of a LPG Tank Failure and Fire



No further risk based analysis of this loss scenario is suggested at this stage of the project.

4.3.3 Preliminary Screening – Off-Site Transport

Off-site transport will be required for all incoming materials needed to construct and operate the McPhillamys Gold Project/Mine. These are intended to be carried in commercial vehicles with site confirmation that incoming suppliers are certified in states traversed against the Australian Code for the Transport of Dangerous Goods by Road and Rail (the Australian Transport Code). This code provides guidance on the signage, packaging integrity, restrictions on products that can be carried (i.e. no mixed loads including acid or low pH liquids for Cyanide) and load cases required to be considered (rough handling and impact).

Some of the goods intended for transport are dangerous in nature and these are discussed in the following sections.

LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis

4.3.3.1 Preliminary Screening – Off-Site Transport – Explosives

Explosives will be required during the construction and operation phases of the project. Regis are intending to use a reputable supplier of explosives and, as such, all supply of material to site will meet the Australian Transport Code. This puts measures in place to limit the potential for initiation of explosives during transport by:

- Requiring containers to be protected against static electricity and to be suitably robust – to withstand normal impact during handling and in transit;
- Providing labelling to warn of the nature of the load – with requirements for no-smoking within 6 metres of the load and with appropriate Decals to provide any emergency responders to adjust their efforts appropriately;
- Separating explosives elements and not carrying mixed loads (by road) once threshold quantities of explosives are included in the load (likely to be the case for loads being transported to site), and;
- By Regis requiring the explosives supplier to select travel routes and times in line with the project requirements (which may include limiting truck movements at sensitive times of day in line with applicable consent conditions).

Explosives have been and continue to be transported around Australia at a tolerable level of risk – and it is not proposed that additional risk based study (e.g. quantification or overpressure analyses) be undertaken for this hazard.

4.3.3.2 Preliminary Screening – Off-Site Transport – Reagents for Ore Processing

Reagents for ore processing include flammable, corrosive and poisonous products. The products and their associated HAZCHEM Codes are shown in the following table.

Table 3 – Transported Reagents

REAGENT	HAZCHEM CODE	COMMENT
QUICKLIME	4W	Used for pH control. Corrosive, causes burns to exposed skin and somewhat toxic.
SODIUM CYANIDE	2X	Used for solubilising Au. Toxic.
SODIUM HYDROXIDE	2W	Used for cleaning and acid neutralisation. Corrosive and can cause burns to exposed skin.
HYDROCHLORIC ACID	2R	Used in the Elution process. Corrosive, burns exposed skin, toxic.
COPPER SULPHATE	2Z	Used for suppressing or catalysing some chemical reactions. Can cause skin irritation and is harmful to the natural environment.

Similar to Explosives, all of these chemicals are currently being and/or are intended for use in the project, and can be safely transported by following the key requirements of the Australian Transport Code. Any site-specific requirements (related to travel times and routes etc.) will be included in supply contracts and reinforced by Regis personnel working at the project.

It is not proposed that additional risk based study is required for transport of the reagents as with conformance to the Code they represent a tolerable level of risk in Australia.

4.3.3.3 Preliminary Screening – Off-Site Transport – Fuels and Flammable Materials

LPG, Diesel and oils for lubrication and hydraulic systems will be transported to site during construction, operation and (to some level) during rehabilitation works.

LFB Resources NL McPhillamys Gold Project

Preliminary Hazard Analysis

All of this material will be sourced from reputable suppliers and similar to Explosives and Reagents, all of these products are currently being and/or are intended for use in the project and can be safely transported by following the key requirements of the Australian Transport Code. Any site-specific requirements (related to travel times and routes etc.) will be included in supply contracts and reinforced by Regis personnel working at the project.

As for other transport scenarios, it is not proposed that any additional risk based study is required for transport of fuels and flammable materials.

5 RISK ANALYSIS AND ASSESSMENT

5.1 PROBABILITY AND MAXIMUM REASONABLE CONSEQUENCE

Potential loss scenarios (primarily based on the identified key potential environmental issues) were ranked for risk by the PHA team. A tabular analysis was used for this risk ranking process, based on the probability and consequence of a loss scenario occurring as developed by the team. This process draws on the skills and experience of the group together with guidance and challenge from the facilitator and naïve team members (to confirm that any underlying assumptions are clearly stated).

The following definition of risk was used:

- the combination of the probability of an unwanted event occurring; and
- the maximum reasonable consequences (MRCs) should the event occur.

The following three tables present the risk ranking matrix tools that were utilised for ranking risks.

Table 4 – Qualitative Measures of Probability

Rank (P)	Probability	Descriptor
A	Almost Certain	Happens often.
B	Likely	Could easily happen.
C	Possible	Could happen and has occurred elsewhere.
D	Unlikely	Hasn't happened yet but could.
E	Rare	Conceivable, but only in extreme circumstances.

Table 5 – Qualitative Measures of Maximum Reasonable Consequence

Ref (C)	Environmental Consequence	Public Safety Consequence
1	Extreme environmental harm	Multiple Fatalities
2	Major environmental harm	Single Fatality, Health or Injury impact that is completely incapacitating or multiple people suffering long term health impacts
3	Serious environmental harm	Single person suffering a long-term health impact or multiple people affected for a time
4	Material environmental harm	Single person affected but able to make a full recovery
5	Minimal environmental harm	Nil impact off site

LFB Resources NL McPhillamys Gold Project Preliminary Hazard Analysis

Note: Maximum Reasonable Consequences: The worst-case consequence that could reasonably be expected, given the scenario and based upon experience at the operation and within the mining industry.

Table 6 – Risk Ranking Table

Consequence (C)	Probability (P)				
	A	B	C	D	E
	1 (H)	2 (H)	4 (H)	7 (M)	11 (M)
	3 (H)	5 (H)	8 (M)	12 (M)	16 (L)
	6 (H)	9 (M)	13 (M)	17 (L)	20 (L)
	10 (M)	14 (M)	18 (L)	21 (L)	23 (L)
	15 (M)	19 (L)	22 (L)	24 (L)	25 (L)

Notes:

L = Low; M = Moderate; H = High

Risk Numbering:

1 = highest risk, 25 = lowest risk

Legend:

Risk Levels:

	Tolerable
	ALARP
	Intolerable

5.2 RISK RANKING

Risk ranking was undertaken by the team on loss scenarios based on the key public health issues which are presented in Table 7 below.

Note that in this table there is a discussion of the scenario to allow the reader to understand the logic being applied in the ranking process.

LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis

Table 7 – Risk Ranking Results

Loss Scenario	Ranking Discussion	P	C	Risk
Generation of HCN from site holdings of NaCN	<p>HCN vapour exists to a small extent over all solutions of NaCN – the higher the pH the lower the vapour pressure present. One remotely plausible scenario is an error in pipework repairs which causes HCl rather than NaOH to be directed into the mixing tank for the NaCN. This reduced pH solution (of HCl and Water) would cause a release of HCN at reasonable quantities when the Cyanoids were added to the tank.</p> <p>Control measures are intended to be applied (ultimately inline with the developing Hazardous Materials Management Plan) to reduce the potential for this to occur and to respond to an unwanted event. These controls include:</p> <ul style="list-style-type: none"> • Maintenance processes which confirm the requirements for and quality of any repair works conducted; • Training and authorisation of workers involved in maintenance and mixing tasks – making them aware of site requirements, including response to incidents and emergencies; • HCN protective clothing – which limits the health impacts from exposure to an atmosphere with elevated HCN; • HCN detection and alarm devices – that sound a siren and transmit alarm status information to the mill control room; • Site emergency response capacity with appropriately resourced, trained workers able to respond to any emergency event (with regular drills involving all site workers), and; • Available reagents to increase the pH of the mixing tank (i.e. rapid dosing with Quicklime (NaOH)). <p>It is conceivable in extreme circumstances (i.e. Rare) that the project would suffer such a loss but the consequences for unprotected workers within a short distance downwind of the tank (i.e. less than 200 metres) would be serious (possible single fatality). The impact for members of the public is much lower – with no significant impacts expected beyond the mine site boundary (of disturbance) – which is a level 5 – nil off-site impact.</p>	E	5	25 (L)

LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis

Loss Scenario	Ranking Discussion	P	C	Risk
Vehicle transporting reagents (including NaCN) is involved in a MVA and generates toxic conditions.	<p>The reagents used by the project will be transported to site by road. Road transport of reagents and other hazardous/dangerous goods occurs currently for industrial purposes in all locations in Australia. The number of major losses which occur are very low. Regis are intending to engage with licensed contractors for supply of reagents and as part of this will confirm that all transport of these goods occurs in line with the relevant Australian Code(s) (by confirming that the carriers are checked (by the contracted suppliers) for compliance with the code and have appropriately qualified drivers and materials handling workers).</p> <p>Freight contractors will be trained in all aspects of reagent handling and safety as well as emergency response procedures.</p> <p>A worst case scenario could be envisaged for most of the reagents that would involve a motor vehicle accident leading to a loss of containment of the reagent being transported and a subsequent fire or reaction which releases toxic fumes around the incident scene.</p> <p>This loss would be mitigated by the integrity of the containers used, warning signage on the transporting vehicle (and the containers), training of responding civil authorities and clean up methods (described in the Safety Data Sheets for each of the reagents).</p> <p>The occurrence of an event where fatalities arise is conceivable in extreme circumstances so would be a rare but significant event.</p>	E	1	11 (M)
Explosives – detonation of the magazine	<p>Some thirty tonnes (in total) of explosives are intended to be stored on site. Magazines and the magazine compound in which they are intended to be stored will meet the requirements of the Australian Standards – and as such the occurrence of this event would require all of the signage and magazine integrity measures to be defeated in the one event. A fire with detonators incorrectly stored in the same location as the boosters could achieve this.</p> <p>This is prevented by: Fire proof construction, removal of vegetation in the magazine compound, firefighting equipment present in the magazine compound, training and authorisation of workers handling explosives, procedures for storing like with like in magazines, licensing audits of magazines, regularly inspection and auditing of magazines, and supervision of workers involved in explosives handling. As for other Hazardous Materials on site, storage and handling of Explosives will be in line with the developing Hazardous Materials Management Plan.</p> <p>If all these controls fail then the magazine will detonate which is countered by: preferential failure of the roof of the magazine to direct the blast upwards, cleanliness of the magazine compound (to limit debris), protective bunds around the magazine (again to redirect energy (over-pressure, flying debris, etc.) from leaving the magazine compound), and distance of the magazine from populated locations.</p> <p>For the public – the initial calculations indicate there is no significant health impact at the disturbance boundary of the project.</p> <p>It is conceivable in extreme circumstances that the magazine could explode but if this were to happen then only negligible injuries to the public could arise.</p>	E	1	25 (L)

LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis

Loss Scenario	Ranking Discussion	P	C	Risk
Explosives – detonation during transport	Explosives will be transported by road to the project site. Similar to the reagents loss above there would be potential for initiation of the explosives being carried is conceivable in extreme circumstances (would require impact with a truck carrying detonators or similar) but the resulting shock waves and debris would prove fatal to any members of the public near the incident. This gives a risk rank of rare and with a maximum consequence.	E	1	11 (M)
Flammable materials – major fire on site	LPG and diesel, required for use during most of the project's life cycle and these are flammable substances. The potential for fire is intended to be mitigated by a combination of: fit for purpose storage locations kept clear of ignition sources and other fuel (e.g. vegetation, rag-waste, etc.); storage containers/tanks appropriately rated for the material; training and induction of workers so they are alert to the requirement to not smoke or introduce ignition sources to these storage areas; signage of the compound (including HAZMAT codes to aid emergency responders); firefighting equipment around the storage location; site emergency responders capable of executing the best response for the arising situation, and; linkage and/or agreements with off-site responding agencies. The potential for an incident to occur is somewhat more likely than the other points here – but is still seen as unlikely given the control measures in place. The consequence, for members of the public based on the fire modelling of the LPG tank would be low.	D	5	21 (L)
Fire of flammable materials in transport	Flammable materials are regularly transported around Australia at a tolerable level of risk. Similar to reagents (above) Regis would engage with reputable providers and transport companies – confirming that they are implementing transport in line with applicable Codes and using qualified and approved workers. This would lead to a conceivable in extreme circumstances event where nearby members of the public could suffer fatal injuries.	E	1	11 (M)

R= Risk - Ranking basis 1 (highest risk) to 25 (lowest risk).

Risk rankings defined as 1 to 6 – High; 7 to 15 - Medium (or ALARP) and 16 to 25 - Low.

The reader should note that the complete range of threats identified in Table 3 above were considered and were filtered to only those where sufficient energy was available to generate an off-site fatality – regardless of the probability of this occurring with the intended control measures in place.

6 MONITOR AND REVIEW

6.1 NOMINATED CO-ORDINATOR

The nominated client review facilitator is Rod Smith - General Manager NSW, LFB Resources NL.

It is understood the nominee will co-ordinate the inclusion of the key potential issues into the various studies undertaken as part of the EIS and the overall Regis management systems.

6.2 COMMUNICATION AND CONSULTATION

Consultation, involvement of personnel (Regis and their specialists) and communication of the process and outcomes of the PHA are intended to be achieved by the inclusion of this report and the relevant specialist assessments addressing the key potential environmental issues in the EIS, and consideration of the report's outcomes in the overall Regis management systems to be implemented for the project.

LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis

6.3 CONCLUDING REMARKS

The PHA and associated risk assessment process conducted by the team was aligned with AS/NZS ISO 31000:2018 and MDG1010 *Minerals Industry Safety and Health Risk Management Guideline* (Department of Trade and Investment, 2011), Applying SEPP 33 and applicable HIPAP documents with the intention of identifying the key potential public health and injury issues for the Project. The PHA has found that the project does not represent an offensive or hazardous development. There are no potential loss scenarios with offsite consequences. Transport of hazardous goods to the mine site, while posing a conceivable issue for off site members of the public, is expected to be adequately addressed through strict conformance with the Australian Code for the transport of Dangerous Goods. Regis will commit to the preparation of hazardous materials management plan which will describe the measures that will be implemented to ensure the safe handling, storage and transportation of hazardous materials used onsite. This plan will also documenting appropriate emergency procedures.

RM would like to thank all of the personnel who contributed to the risk assessment in particular those personnel from Regis who prepared source material for the team session.

Peter Standish, May 2019

LFB Resources NL McPhillamys Gold Project
Preliminary Hazard Analysis

7 ATTACHMENT A – DEFINITIONS

ALARP	“As Low As Reasonably Practicable”. The level of risk between tolerable and intolerable levels that can be achieved without expenditure of a disproportionate cost in relation to the benefit gained.
AS/NSZ ISO 31000:2018	Australian Standard/New Zealand Standard on Risk Management (see references in Section 6).
Cause	A source of harm.
Control	An intervention by the proponent intended to either Prevent a Cause from becoming an incident or to reduce the outcome should an incident occur.
EARs.	Environmental Assessment Requirements.
ERA	Environmental Risk Assessment.
Geomet	Common short form for describing the science of/professionals involved in Geological Metallurgy.
HIPAP	Acronym – NSW Department of Planning and Industry’s Hazardous Industry Planning Advisory Paper.
MDG1010	Department of Primary Industries guideline on risk management (see references in Section 6).
Outcome	The end result following the occurrence of an incident. Outcomes are analogous to impacts and have a risk ranking attached to them.
Personnel	Includes all people working in and around the site (e.g. all contractors, sub-contractors, visitors, consultants, project managers etc.).
PHA	Abbreviation – Preliminary Hazard Assessment
Practicable	The extent to which actions are technically feasible, in view of cost, current knowledge and best practices in existence and under operating circumstances of the time.
RA	Abbreviation for Risk Assessment
Review	An examination of the effectiveness, suitability and efficiency of a system and its components.
Risk	The combination of the potential consequences arising from a specified hazard together with the likelihood of the hazard actually resulting in an unwanted event.
RM	An abbreviation used in place of Risk Mentor Pty Ltd.
Worst Case Loss	An incident outcome which is the ultimate result of the release of energy from all of the available sources present at the incident site.

LFB Resources NL McPhillamys Gold Project Preliminary Hazard Analysis

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