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SLR Consulting (Australia) Pty Ltd

## Northern Star Resources Ltd

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Dear Duanne,

### **Re: Hemi Gold Project – Ecological Risk Assessment for Matters of National Environmental Significance**

SLR Consulting (Australia) Pty Ltd (SLR) was commissioned by Northern Star Resources Ltd (NSR or the Client) to assess the geochemical risks to Matters of National Environmental Significance associated with the Hemi Gold Project (Hemi or the Project).

This memorandum provides an overview of the Project and presents a qualitative assessment of potential risks to key conservation significant species associated with waste rock geochemistry and pit lake water quality.

## **1. Introduction**

NSR is proposing to develop the Hemi Gold Project (the Project), located in the Pilbara Region of Western Australia, approximately 85 kilometres south of the Town of Port Hedland. The Project involves the development of five open pits (Aquila/Crow, Broilga, Diucon, Eagle, and Falcon), construction of an integrated waste landform (IWL) tailings storage facility (TSF), stockpiling of waste rock and low-grade ore, and associated mine support infrastructure.

Fauna surveys (Western Wildlife 2022) have identified 33 conservation significant terrestrial fauna species with the potential to occur within the Project's Development Envelope, including several species listed as Endangered or Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Among these Matters of National Environmental Significance (MNES) are the Greater Bilby (*Macrotis lagotis*), Northern Quoll (*Dasyurus hallucatus*), Pilbara Olive Python (*Liasis olivaceus barroni*), and Pilbara Leaf-nosed Bat (*Rhinionictes aurantia* – Pilbara form).

Although the Project design incorporates management measures to minimise impacts to conservation significant species, stakeholders have requested further information on the potential for toxicological impacts associated with mine waste materials and post-closure pit lake water quality. This includes the risks of acid and metalliferous drainage (AMD), saline seepage, and the potential use of pit lakes by MNES fauna post-mining.

This memorandum has been prepared to provide a high-level, qualitative and conservative assessment of the geochemical and toxicological risks to MNES species associated with mine waste rock products and post-closure pit lakes. The assessment broadly follows a standard ecological risk assessment (ERA) framework, including assessment of the following aspects:

- Hazard Identification: Characterisation of waste materials and potential geochemical processes, notably AMD and pit lake water quality.

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- Exposure Assessment: Evaluation of potential pathways by which MNES species may be exposed to contaminants associated with waste rock landforms or pit lakes.
- Effects Assessment: Consideration of the potential toxicological or ecological consequences if exposure were to occur.
- Conceptual Site Model: Consolidated summary showing the source, pathway and exposure processes.
- Risk Characterisation: Integration of hazard, exposure, and effects assessments to determine the overall likelihood and significance of ecological risk for each MNES species.

## 2. Receptors – Matters of National Environmental Significance

Seven species listed under the EPBC Act are predicted to occur in the Project area. These are detailed in **Table 2-1** along with their likelihood of occurrence and survey notes.

**Table 2-1 MNES Species (Western Wildlife 2022)**

Species	EPBC Act Status	Likelihood of Occurrence	Recorded in Disturbance Envelope	Notes
<i>Pezoporus occidentalis</i> – <b>Night Parrot</b>	Endangered	Possible	Not Recorded	This species has been recorded at only a few locations across Australia. The limited patches of mature spinifex habitats in the study area are technically suitable habitat.
<i>Dasyurus hallucatus</i> – <b>Northern Quoll</b>	Endangered	Known to occur	Recorded	Recorded in the study area in September 2021 and March 2022. Likely to be a resident of the Rocky Outcrops (excluded from the Disturbance Envelope) and Major River habitats, dispersing and foraging in adjacent habitats).
<i>Macrotis lagotis</i> – <b>Greater Bilby</b>	Vulnerable	Known to occur	Secondary sign recorded	Secondary signs, mostly of old burrows (inactive but active in the past year) recorded (outside of Project Disturbance Footprint).
<i>Rhinonicteris aurantia</i> – <b>Pilbara Leaf-nosed Bat</b>	Vulnerable	Known to occur	Recorded	Recorded in the study area in September 2021 and March 2022. Likely to be a regular foraging visitor to all habitats, particularly of the Rocky Outcrops and Major River habitats. No diurnal roosting habitat present.
<i>Macroderma gigas</i> – <b>Ghost Bat</b>	Vulnerable	Likely	Not Recorded	Likely to be a foraging visitor to all habitats. No diurnal roosting habitat present with the closest known roost approximately 27 km from the pits.
<i>Liasis olivaceus barroni</i> – <b>Pilbara Olive Python</b>	Vulnerable	Known to occur	Not Recorded	Known to occur nearby, this species is likely to be a foraging visitor and possible breeding resident of the Major River and Rocky Outcrop habitats.
<i>Falco hypoleucos</i> – <b>Grey Falcon</b>	Vulnerable	Known to occur	Not Recorded	Known to occur nearby, this species is likely to be a foraging visitor to open habitats and possible breeding resident of the Major River habitat.



Of the conservation significant fauna identified, this assessment focuses on the four MNES species that were considered in both the Part IV and EPBC referrals as potentially subject to significant impacts from the Project. These species comprise:

- *Macrotis lagotis* – Greater Bilby
- *Dasyurus hallucatus* – Northern Quoll
- *Liasis olivaceus barroni* – Pilbara Olive Python
- *Rhinioncteris aurantia* – Pilbara Leaf-nosed Bat

This ERA has been undertaken to assess potential exposure pathways for these species, evaluating the likelihood and consequence of impacts associated with AMD or saline drainage generation and pit lake water quality in the post-mining environment.

### 3. Hazard Identification

The primary geochemical hazards at Hemi relate to the management of waste rock landforms and the long-term water quality of pit lakes at closure. Both aspects have been the focus of extensive characterisation and predictive modelling. The following subsections describe the key hazards and their potential to affect the four identified MNES species.

#### 3.1 Waste Rock Geochemistry

Geochemical characterisation of waste rock has included static and kinetic test programs, acid–base accounting, net acid generation (NAG) testing, and leachate analysis (SRK, 2022, 2023b, 2023a, 2024). These studies demonstrate that the vast majority of waste rock produced during mining at Hemi is non-acid forming (NAF). Less than five percent of the material has been identified as potentially acid forming (PAF) and is restricted to specific lithological units such as black shales.

The main hazard associated with PAF waste rock is the potential for AMD, should sulphide-bearing PAF materials be exposed to oxygen and water. AMD can lead to acidic drainage enriched in dissolved metals, which may degrade local soils and water quality.

To manage this risk, the Project incorporates a comprehensive encapsulation strategy whereby PAF rock is buried within the core of engineered waste rock landforms, surrounded by NAF material to limit oxygen and water ingress. This approach is consistent with best practice and is effective at preventing oxidation and AMD formation.

The Project's arid climate provides an additional natural safeguard. Evaporation significantly exceeds rainfall, limiting the infiltration of water through the waste rock landforms. Any infiltration is expected to be minimal, of short duration, and unlikely to produce surficial discharges.

#### 3.2 Post Closure Pit Lake Water Quality

At closure, open pits will gradually fill with groundwater, forming pit lakes between 110 m and 140 m below natural ground level. Hydrogeological modelling indicates that these lakes will function as groundwater sinks, drawing in surrounding groundwater rather than discharging to the environment (Geowater, 2024). This hydraulic behaviour ensures that any contaminants mobilised within the pit remain contained.

Initially, pit lake water is expected to be fresh. Over time, the primary toxicological hazard is the progressive increase in salinity driven by evaporation, which exceeds rainfall by an order of magnitude. As solute concentrations rise, the pit lake is predicted to become increasingly saline, eventually reaching unpalatable and unsuitable conditions for drinking by mammals and reptiles (including the Greater Bilby, Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python) within approximately 150 years post-closure.



A secondary hazard relates to potential increases in dissolved metals. Groundwater inflows from the reinjection borefield will eventually contribute to the pit lake system. This water contains elevated metal concentrations, notably arsenic. However, inputs will be progressive and significantly diluted by the surrounding aquifer and the pit lake itself. Arsenic concentrations are not expected to reach levels that would cause acute toxicity, and occasional or infrequent access by fauna would therefore present negligible risk.

Additional metal inputs could arise if residual sulphide-bearing pit walls below the waterline oxidise and generate acidity. Given the limited quantity of exposed sulphides remaining after mining, any resulting metal mobilisation is expected to be minimal relative to the total lake volume. Overall, groundwater-derived metal contributions are expected to be minor compared to the strong salinity-driven trajectory of the lake.

Consequently, long-term water quality will be dominated by salinity rather than metals. The resulting conditions are expected to be of low ecological value and unattractive as a drinking source, thereby limiting exposure pathways and reducing the likelihood of impacts to MNES species. This is accompanied by the highly modified environment of the pit voids and their immediate surroundings within the abandonment bunds, lacking the spinifex sandplains and drainage lines utilised by the MNES species, making the interaction increasingly unlikely.

## 4. Exposure Assessment

The purpose of the exposure assessment is to evaluate whether the four MNES species of concern (Greater Bilby, Northern Quoll, Pilbara Olive Python, and Pilbara Leaf-nosed Bat) are likely to come into contact with geochemical hazards associated with the Project's waste rock landforms and/or the post closure pit lakes. This involves consideration of species ecology, behaviour, and habitat use in relation to potential pathways from waste rock landforms and pit lakes.

### 4.1 Greater Bilby

Secondary signs of the Greater Bilby have been recorded within the Development Envelope and mapped critical habitat overlaps the entire waste rock landforms footprint. This raises the possibility of interaction between the landforms and the Greater Bilby during operations and post-closure.

Potential exposure pathways include direct ingestion of seepage water emerging from waste rock landforms or indirect exposure through the use of contaminated soils in burrowing and foraging activities. However, the risk of such exposure is inherently low. SLR notes that quantities of PAF materials are limited (5% of total waste rock) and best practice management and encapsulation will ensure that AMD generation is highly unlikely. The likelihood is further reduced due to the arid climate that minimises infiltration and limits the duration of any percolation through the waste rock landforms.

During operations, the Greater Bilby is unlikely to frequent the waste rock landforms due to active mining activity (e.g. equipment use, traffic and noise). This operational period will provide an opportunity to validate predicted waste rock behaviour and, if necessary, adapt management or closure measures, further reducing the likelihood of any surficial AMD production.

In the unlikely event that any surficial seepage is produced, it will be saline and unpalatable and therefore avoided by the Greater Bilby as a drinking source. Bilbies are adapted to arid conditions and can meet most of their moisture needs through their diet.

Overall, SLR considers the likelihood of the Greater Bilby being exposed to toxic water or contaminated substrates from waste rock landforms to be minimal.

The pit voids with their steep-sided morphology, depth and distance to water, and eventual salinity will make them physically and physiologically unattractive to the Greater Bilby.



## 4.2 Northern Quoll

The Northern Quoll typically inhabits rocky escarpments, creeks, and rugged terrain that provide denning opportunities and food resources. Such habitats are not present within or adjacent to the waste rock landforms or pit lakes at Hemi.

There are no identified pathways by which Northern Quolls could be exposed to AMD or saline seepage from waste rock. Similarly, pit lakes at closure will not provide suitable habitat or attract prey species in abundance, particularly given their increasing salinity and low productivity. The species is unlikely to drink from, forage around, or den near pit lakes.

## 4.3 Pilbara Olive Python

The Pilbara Olive Python is typically associated with rocky gorges and riparian zones that provide access to permanent or semi-permanent freshwater habitats supporting its primary prey, including waterbirds, mammals, and reptiles. The species' occurrence is therefore strongly linked to the presence of freshwater systems that sustain an adequate prey base.

Although Pilbara Olive Pythons may range up to 3 - 4 km from core habitat when seeking mates, the nearest core habitat is approximately 7.5 km from the proposed pits, placing them beyond the species' typical dispersal range. In addition to being beyond the typical dispersal range, pit lakes are unlikely to be frequented by the Pilbara Olive Python due to the limited access and low ecological productivity. This likelihood will be further reduced as pit water salinities increase over time reducing the palatability of the water. Considering these ecological and physical constraints, the pit lakes are highly unlikely to provide suitable habitat or water resources for the species. Consequently, the Pilbara Olive Python has no credible exposure pathway to degraded pit lake water.

While no critical habitat occurs within the waste rock storage areas, suitable dispersal corridors may exist in the surrounding landscape. As such, Pilbara Olive Pythons may occasionally traverse or briefly occupy these areas. Given the limited potential for AMD generation from the waste rock landforms, combined with the species' infrequent presence, the overall risk of exposure to contaminated seepage is considered very low.

## 4.4 Pilbara Leaf-nosed Bat

The Pilbara Leaf-nosed Bat is a cave-roosting species that primarily forages within rocky gorges and riparian habitats where insect prey is abundant. Acoustic monitoring has recorded occasional overflight activity within the Development Envelope; however, no suitable roosting sites or high-quality foraging habitat occur within the Project footprint.

Initial pit lake water will be fresh, noting that the ecological productivity of the system will remain low given the depth to water, absence of vegetation and steep rugged pit walls. The low ecological productivity will limit insect abundance, reducing the likelihood of foraging activity. Progressive salinisation over time will render pit lake water increasingly unsuitable for drinking. Given the substantial depth to water, steep pit walls, low ecological productivity and absence of shallow shorelines, the pit lakes are unlikely to be accessible or attractive to bats, even during the early post-closure period when salinity remains low.

Waste rock storage areas provide neither roosting habitat nor suitable foraging conditions and therefore represent no credible exposure pathway.

The overall likelihood of exposure of Pilbara Leaf-nosed Bats to pit lake waters is very low with no plausible exposure pathways to AMD from waste rock landforms.



## 5. Potential Toxicological Effects Following Exposure

The effects assessment considers the potential ecological or toxicological consequences for the four MNES species should exposure to AMD or pit lake water occur through ingestion or dermal contact. Consistent with a Tier 1 approach, conservative assumptions have been applied and worst-case scenarios considered. In practice, however, the likelihood of such exposure is considered extremely low for each MNES species, as detailed in Section 4.

Potential toxicological stressors have been identified as follows:

- Acidity (low pH): Resulting from oxidation of sulphidic minerals, leading to increased solubility and mobility of metals.
- Dissolved metals and metalloids: Such as arsenic, antimony, copper, tungsten and zinc, which may leach under acidic conditions.
- Salinity (elevated total dissolved solids): Driven by the arid climate and high evaporation rates, leading to saline conditions in seepage or pit lake water.

Toxicological effects associated with AMD exposure are broad and subject to a range of factors. Acute exposure is likely comparable between all four MNES species, resulting in gastrointestinal distress and/or systemic toxicity while chronic exposure could lead to behavioural changes, lethargy, or organ dysfunction.

Elevated salinity present in AMD or pit lake water imposes osmotic stress and dehydration in mammals and reptiles and generally causes rapid avoidance. Even moderate salinity reduces palatability, meaning repeated exposure is unlikely.

While acidic, metal-enriched, or saline waters can present significant toxicological risks, the likelihood of sustained receptor contact is low. The limited presence of PAF materials, combined with engineering controls such as encapsulation and cover systems, and the region's naturally arid climate, will minimise the generation of persistent contaminated seepage from waste rock landforms. Similarly, pit lake water will be largely inaccessible due to steep pit walls and is expected to become increasingly saline and unpalatable over time.

Any exposure that does occur is expected to be infrequent, short-term, and primarily associated with elevated salinity rather than AMD. High salinity levels typically elicit avoidance behaviours in fauna, further reducing the potential for harmful interaction. Consumption of pit lake water during the initial period when it remains fresh is not expected to cause adverse physiological effects in terrestrial fauna.

## 6. Conceptual Site Model

Conceptual site models (CSM) have been developed to summarise the geochemical processes, contaminant transport pathways, and potential exposure routes relevant to the waste rock landforms and pit lake. The CSMs form the basis of the ecological risk assessment, providing a structured representation of how waste materials or pit lake waters, environmental processes, and fauna interactions could intersect. They also demonstrate the multiple levels of control, both natural and engineered, that minimise risks to MNES species.

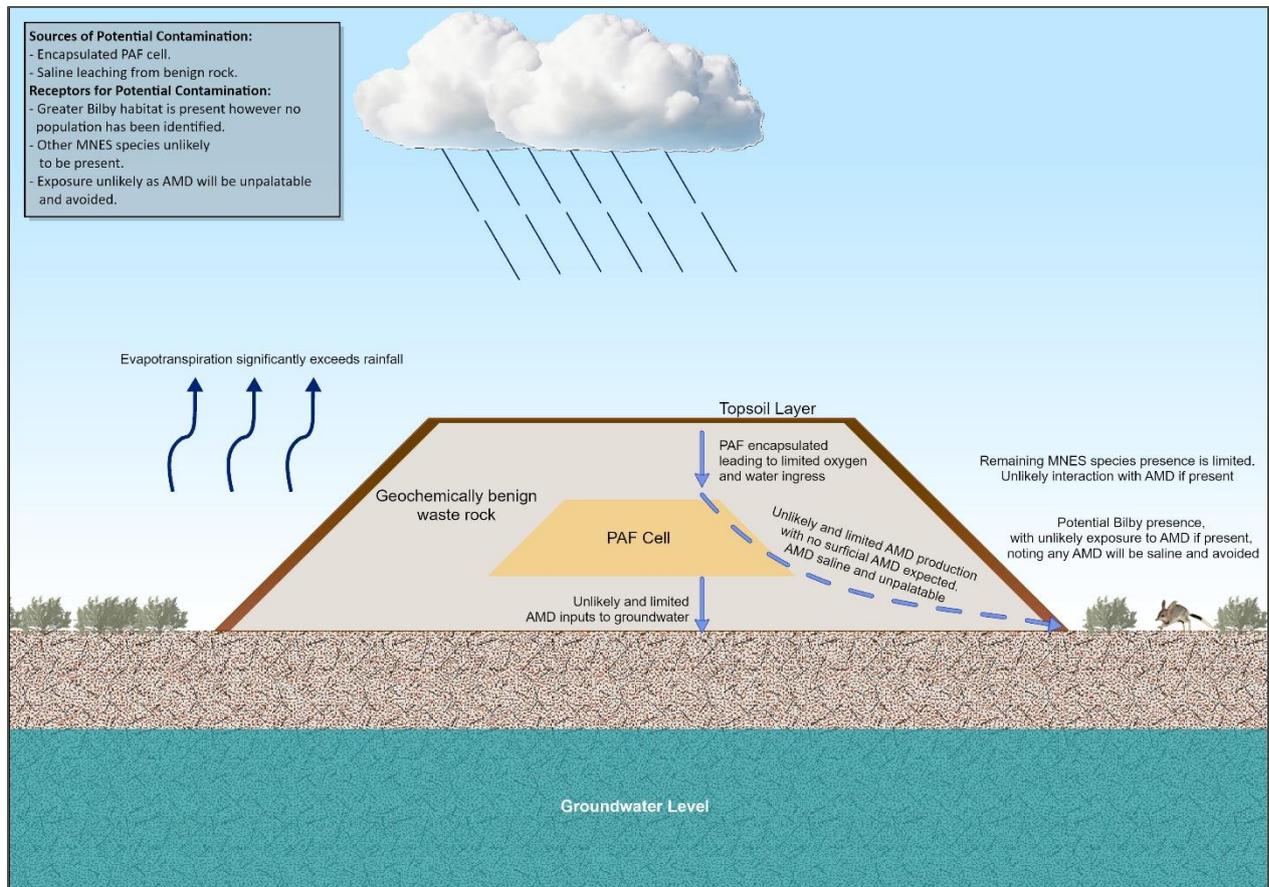
### 6.1 Waste Rock Landforms

The CSM for the waste rock landforms is provided in **Figure 6-1** and depicts the key processes influencing seepage quality and potential ecological exposure. PAF material is encapsulated within NAF rock to prevent contact with oxygen and water, while engineered covers and armouring reduce infiltration and erosion. Under the arid climatic conditions of the Pilbara, rainfall events are infrequent and short-lived, with evaporation rates significantly exceeding rainfall. As a result, infiltration is minimal, and any seepage that does occur is more likely to be mineralised or saline rather than acidic.



The CSM illustrates plausible transport pathways, including limited infiltration through the WRD, surface runoff and ephemeral pooling at the landform toe. Exposure pathways for MNES species include direct drinking of surficial AMD, and incidental ingestion or contact with contaminated sediments. However, the model also shows natural avoidance behaviours driven by salinity, as well as the engineering controls in place that minimise formation of acidic drainage and limit accessibility of any seepage.

**Figure 6-1 Conceptual Site Model – Waste Rock Landforms**



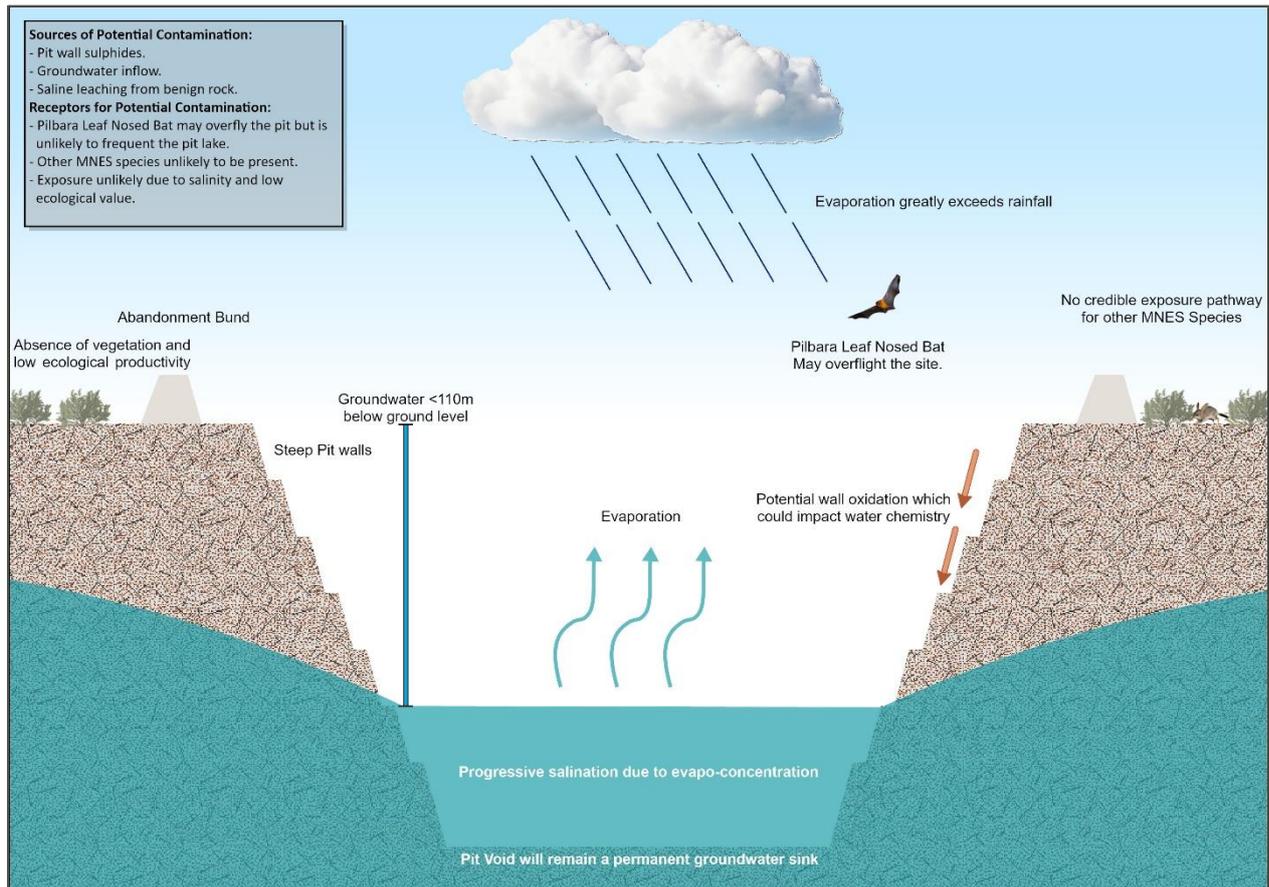
## 6.2 Pit Lake

The pit lake CSM is provided in **Figure 6-2** and shows the post-closure evolution of mine voids into waterbodies recharged primarily by groundwater inflow and episodic rainfall. Inflow water is subject to strong evaporative concentration under the local Pilbara climatic conditions, leading to progressive salinisation of the lake. Localised acidic or metal-rich inputs may occur where pit walls expose sulphidic lithologies, but these contributions are spatially constrained and are diluted within the broader lake volume.

Potential exposure pathways represented in the CSM are limited to direct drinking by fauna at accessible points within the pit, notably the pit ramps. The depth to water, steep pit walls, engineered safety bunds, absence of vegetation or cover, and physical inaccessibility will make access to these locations very unlikely for MNES species. Any exposures that do occur are expected to be episodic and short-lived, with salinity dominating as the key stressor, driving avoidance behaviour by all MNES species.



Figure 6-2 Conceptual Site Model – Pit Lake





## 7. Risk Characterisation

The findings of the preceding sections (hazard identification, exposure assessment, effects assessment, and conceptual site model) have been considered to provide an overall evaluation of the likelihood and consequence of potential adverse impacts to the identified MNES species of concern. The risk assessment is provided in **Attachment 1**. A summary of identified risk ratings for each MNES species by hazard is provided in **Table 7-1**.

**Table 7-1 Risk Rating to MNES Species by Hazard**

Receptor	Risk Rating by Hazard	
	AMD or Saline Drainage from the Waste Rock Landforms	Pit Lake Water
<i>Macrotis lagotis</i> – <b>Greater Bilby</b>	Low Risk	No credible exposure pathway
<i>Dasyurus hallucatus</i> – <b>Northern Quoll</b>	No credible exposure pathway	No credible exposure pathway
<i>Liasis olivaceus barroni</i> – <b>Pilbara Olive Python</b>	No credible exposure pathway	No credible exposure pathway
<i>Rhinioncteris aurantia</i> – <b>Pilbara Leaf-nosed Bat</b>	No credible exposure pathway	Low Risk



## 8. Conclusion

The ecological risk assessment indicates that geochemical hazards associated with waste rock landforms and post-closure pit lakes present a very low likelihood of adverse impacts to MNES species. Comprehensive geochemical characterisation has confirmed that the overwhelming majority of waste rock is non-acid forming, with only a small proportion identified as potentially acid forming. These materials will be managed through best-practice encapsulation within engineered landforms, supported by cover systems and erosion controls. Combined with the arid Pilbara climate, which limits infiltration and promotes evaporation, these measures substantially reduce the potential for acid and metalliferous drainage generation. Any seepage that does occur is expected to be saline and unpalatable, further discouraging use by fauna.

Access to pit lakes is unlikely to occur post closure due to the depth and distance to water, physical inaccessibility, absence of vegetation or cover and low ecological productivity. Post-closure pit lakes will operate as groundwater sinks and progressively become saline due to high evaporation rates. While minor inputs of acidity or metals may occur from exposed sulphidic pit walls, these contributions will be spatially limited and diluted within the lake system. Over time, salinity will dominate water chemistry, rendering the lakes undesirable as drinking water resources.

Exposure pathways for the four MNES species assessed (Greater Bilby, Northern Quoll, Pilbara Olive Python and Pilbara Leaf-nosed Bat) are either absent or highly improbable. Where interaction could occur, natural avoidance behaviours and species-specific adaptations, such as low reliance on surface water, further reduce the likelihood of contact. Risk characterisation confirms that all identified hazards are rated as low or have no credible pathway following implementation of proposed management measures.

In summary, SLR concludes that the combination of engineered controls, natural climatic conditions and species ecology ensures that geochemical hazards associated with the Project are unlikely to result in significant ecological impacts to MNES species. Application of best-practice management during operations and closure will maintain this low level of residual risk.

Sincerely,

**James Cumming**  
Principal Environmental Advisor



## **IMPORTANT INFORMATION ABOUT THIS DOCUMENT**

The recommendations contained in this memorandum may change in the event that information supplied to and reviewed by SLR is inaccurate or is materially changed or if any information material to the result was not provided to SLR for review. In SLR's opinion, the information provided by or on behalf of Northern Star Resources Ltd was reasonable and during the preparation of this memorandum there was nothing discovered to suggest that there was information withheld or misrepresented. Northern Star Resources Ltd has not advised SLR of any material change in the information provided, is not aware of any information that may be relevant to the review that was not provided to SLR and is not aware of any event likely to cause material change to the recommendations made by SLR as at the date of this memorandum. Unforeseen changes in legislation, new industry developments and other factors specific to mining that cannot be fully anticipated by SLR may impact the information and recommendations contained in this memorandum.



## Attachment 1 Risk Assessment

Risk is a measure of likelihood versus consequence for a given scenario. Identified risks were categorised according to significance using a five-by-five risk matrix, with pre-defined criteria for “Likelihood” and “Consequence” categories. Consequence definitions focus on physiological impacts while likelihood criteria are adapted to qualitative descriptions of probability.

The risk matrix and criteria used to inform the risk assessment are shown in Table 1. The risk assessment is provided in Table 2.

**Attachment Table 1 Risk Matrix**

Likelihood		Consequence				
		Insignificant No measurable adverse effect	Minor Mild, short-term physiological stress	Moderate Reduced health or local population effects	Major Population decline or loss of ecological function	Catastrophic Widespread, long-term or irreversible damage
<b>Almost Certain</b>	Expected to occur	Medium	High	High	Extreme	Extreme
<b>Likely</b>	Will probably occur	Medium	Medium	High	Extreme	Extreme
<b>Possible</b>	Could occur at some time	Low	Medium	Medium	High	Extreme
<b>Unlikely</b>	Not expected but plausible	Low	Low	Medium	High	High
<b>Rare</b>	Exceptional circumstances only	Low	Low	Medium	Medium	High



**Attachment Table 2 Ecological Risk Assessment**

Receptor (MNES Species)	Hazard	Source	Pathway	Exposure	Description of Impact	Likelihood	Consequence	Inherent Risk	Treatment / Management - Operations	Treatment / Management - Closure	Likelihood	Consequence	Residual Risk	Overall Risk
<b>Waste Rock Landforms Ecological Risk Assessment</b>														
<i>Macrotis lagotis</i> – Greater Bilby	AMD or saline drainage.	PAF waste rock materials contained within the waste rock landforms.	Water infiltration and oxidation of PAF materials resulting in lateral migration of AMD or saline drainage to the landform embankments and/or toe. AMD/saline drainage expected to be ephemeral given the arid environment and high evaporation rates. Any AMD is expected to present as damp soil or temporary shallow pools in discrete locations along the toe of the landform.	The waste rock landforms are located within habitat critical to Greater Bilby. Bilbies may be present and could interact with AMD or saline mine drainage from the landforms.	Dermal contact is unlikely to result in physiological impacts. Ingestion is unlikely as AMD/saline drainage will be unpalatable and avoided. If ingested, systemic toxicological impacts could occur affecting individuals rather than populations.	Unlikely	Moderate	Medium	Comprehensive materials characterisation. Approved best practice waste rock management. Approved best practice PAF management and encapsulation. Operational presence, monitoring and adaptive management should AMD occur.	NSR proposes to rehabilitate the landforms using best industry practice, including encapsulation of PAF materials within geochemically benign waste rock, erosion protection, drainage management and revegetation. Rehabilitation performance monitoring is required following closure and will identify potential geochemical issues.	Rare	Insignificant	Low	The waste rock landforms are located in bilby habitat, although no sightings have been recorded. If present, the bilby population is low. The likelihood of bilbies interacting with waste rock landforms is considered possible. Following NSR proposed PAF management and closure provisions and with consideration to the arid environment, the likelihood of bilbies interacting with AMD is considered rare. AMD or saline drainage is unpalatable and will be avoided by bilbies. The overall level of risk to bilbies associated with PAF waste rock materials is considered low.
<i>Dasyurus hallucatus</i> – Northern Quoll	AMD or saline drainage.	PAF waste rock materials contained within the waste rock landforms.	Water infiltration and oxidation of PAF materials resulting in lateral migration of AMD or saline drainage to the landform embankments and/or toe. AMD/saline drainage expected to be ephemeral given the arid environment and high evaporation rates. Any AMD is expected to present as damp soil or temporary shallow pools in discrete locations along the toe of the landform.	The waste rock landforms are not located in Northern Quoll habitat. The waste rock landforms are not expected to provide suitable habitat or attract prey species. There are no credible pathways to expose the Northern Quoll to AMD or saline drainage from the waste rock landforms.	Dermal contact is unlikely to result in physiological impacts. Ingestion is unlikely as AMD/saline drainage will be unpalatable and avoided. If ingested, systemic toxicological impacts could occur affecting individuals rather than populations.	Rare	Moderate	Medium	Comprehensive materials characterisation. Approved best practice waste rock management. Approved best practice PAF management and encapsulation. Operational presence, monitoring and adaptive management should AMD occur.	NSR proposes to rehabilitate the landforms using best industry practice, including encapsulation of PAF materials within geochemically benign waste rock, erosion protection, drainage management and revegetation. Rehabilitation performance monitoring is required following closure and will identify potential geochemical issues.	Rare	Insignificant	Low	There is no credible exposure pathway where Northern Quolls could ingest or be impacted by AMD or saline drainage from the waste rock landforms.



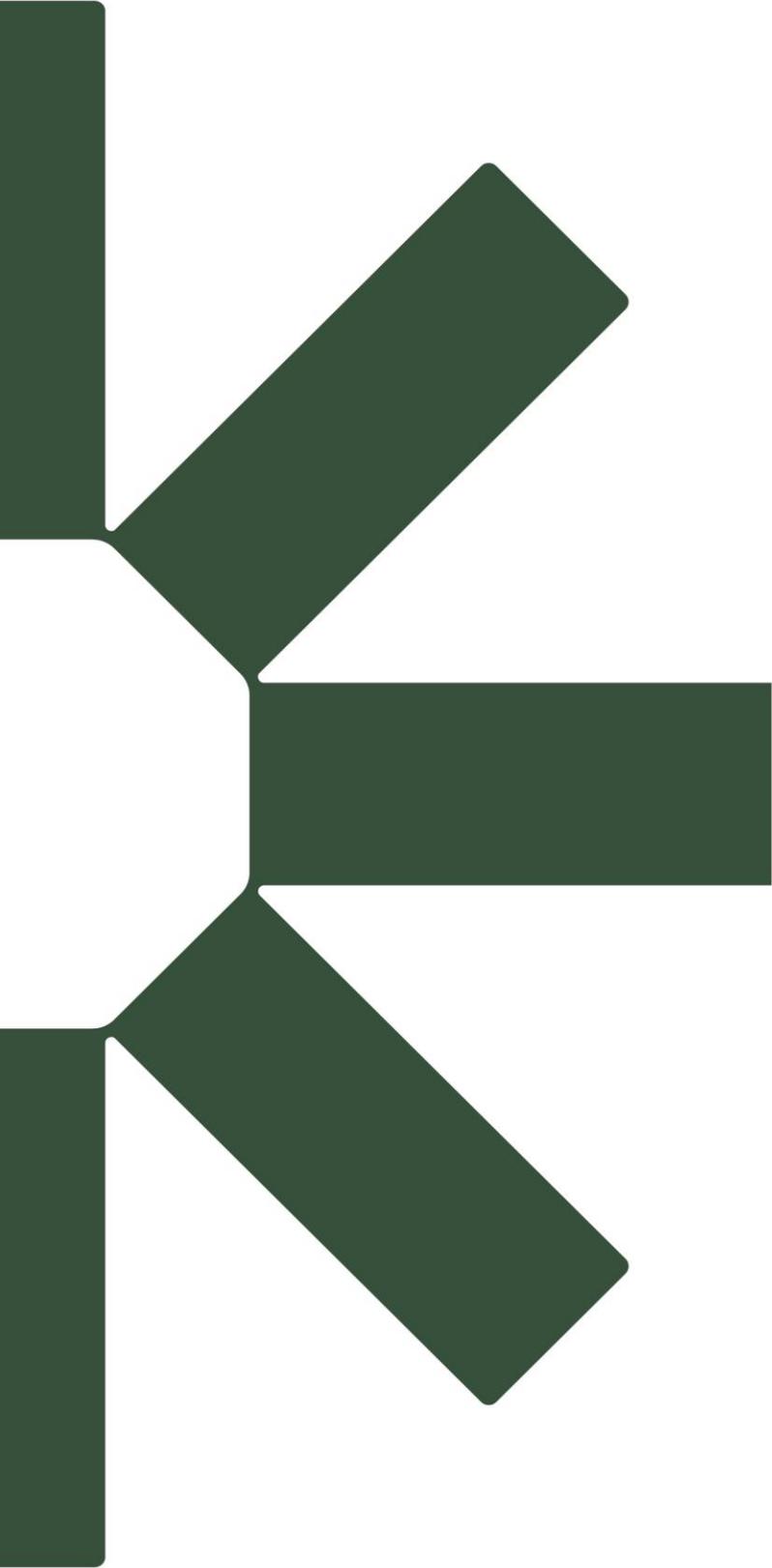
Receptor (MNES Species)	Hazard	Source	Pathway	Exposure	Description of Impact	Likelihood	Consequence	Inherent Risk	Treatment / Management - Operations	Treatment / Management - Closure	Likelihood	Consequence	Residual Risk	Overall Risk
<i>Liasis olivaceus barroni</i> – Pilbara Olive Python	AMD or saline drainage.	PAF waste rock materials contained within the waste rock landforms.	Water infiltration and oxidation of PAF materials resulting in lateral migration of AMD or saline drainage to the landform embankments and/or toe. AMD/saline drainage expected to be ephemeral given the arid environment and high evaporation rates. Any AMD is expected to present as damp soil or temporary shallow pools in discrete locations along the toe of the landform.	The Pilbara Olive Python is strongly associated with rocky gorges and riparian zones where it hunts waterbirds, mammals, and reptiles. It relies on the presence of permanent or semi-permanent fresh water bodies to sustain its prey base. These habitats are absent from the waste rock storage areas and the vicinity of pit lakes.	Dermal contact is unlikely to result in physiological impacts. Ingestion is unlikely as AMD/saline drainage will be unpalatable and avoided. If ingested, systemic toxicological impacts could occur affecting individuals rather than populations.	Rare	Moderate	Medium	Comprehensive materials characterisation. Approved best practice waste rock management. Best practice PAF management and encapsulation. Operational presence, monitoring and adaptive management should AMD occur.	NSR proposes to rehabilitate the landforms using best industry practice, including encapsulation of PAF materials within geochemically benign waste rock, erosion protection, drainage management and revegetation. Rehabilitation performance monitoring is required following closure and will identify potential geochemical issues.	Rare	Insignificant	Low	There is no credible exposure pathway where the Pilbara Olive Python could ingest or be impacted by AMD or saline drainage from the waste rock landforms.
<i>Rhinonicteris aurantia</i> – Pilbara Leaf-nosed Bat	AMD or saline drainage.	PAF waste rock materials contained within the waste rock landforms.	Water infiltration and oxidation of PAF materials resulting in lateral migration of AMD or saline drainage to the landform embankments and/or toe. AMD/saline drainage expected to be ephemeral given the arid environment and high evaporation rates. Any AMD is expected to present as damp soil or temporary shallow pools in discrete locations along the toe of the landform.	The Pilbara Leaf-nosed Bat is cave-roosting and forages primarily in gorge and riparian habitats where insect prey is abundant. Acoustic monitoring has confirmed occasional overflight of individuals within the Development Envelope, but no roosting habitat or high-quality foraging areas occur within the Project footprint.. The species is unlikely to drink water that is moderately saline (above 3,200 mg/L) as it primarily maintains hydration through its diet.	Dermal contact is unlikely to result in physiological impacts. Ingestion is unlikely as AMD/saline drainage will be unpalatable and avoided. If ingested, systemic toxicological impacts could occur affecting individuals rather than populations.	Rare	Moderate	Medium	Comprehensive materials characterisation. Approved best practice waste rock management. Approved best practice PAF management and encapsulation. Operational presence, monitoring and adaptive management should AMD occur.	NSR proposes to rehabilitate the landforms using best industry practice, including encapsulation of PAF materials within geochemically benign waste rock, erosion protection, drainage management and revegetation. Rehabilitation performance monitoring is required following closure and will identify potential geochemical issues.	Rare	Insignificant	Low	There is no credible exposure pathway where the Pilbara Leaf Nosed Bat could ingest or be impacted by AMD or saline drainage from the waste rock landforms.



Receptor (MNES Species)	Hazard	Source	Pathway	Exposure	Description of Impact	Likelihood	Consequence	Inherent Risk	Treatment / Management - Operations	Treatment / Management - Closure	Likelihood	Consequence	Residual Risk	Overall Risk
<b>Pit Lake Ecological Risk Assessment</b>														
<i>Macrotis lagotis</i> – Greater Bilby	Mineralised or saline pit lake water.	Residual PAF minerals in the pit walls, natural salinity of groundwater inflows.	Oxidation of PAF or mineralised pit walls and evapoconcentration of dissolved minerals over time resulting in a saline and potentially toxic source of water of low ecological value.	Access to pit lake water is improbable due to the depth and distance to water, physical inaccessibility, absence of vegetation or cover, low ecological productivity or prey base and limited shallow access points. Modelling indicates that pit lakes will become saline over time further reducing the likelihood of the species frequenting the pit lakes.	Initial water quality will be fresh and non-toxic. Pit lake water will become saline in the long term. This will be unpalatable and avoided by most species, including the Greater Bilby. If ingested, systemic toxicological impacts could occur affecting individuals rather than populations.	Rare	Minor	Low	A pit lake will not be present during operations.	NSR proposes to construct an abandonment bund around the pit at closure, while retaining the operational safety bund. These measures are expected to be effective at minimising access to the pit by the Greater Bilby.	Rare	Insignificant	Low	Whilst the pit is situated within suitable Greater Bilby habitat, during operations mining activities such as blasting, crushing, use of heavy machinery, vehicle movement and noise and light pollution from the processing plant are expected to deter the Greater Bilby from the area. After closure, the pit will not provide any foraging value and is very unlikely to be frequented by the Greater Bilby as a source of water, particularly as bilbies obtain the majority of their water needs from their diet. There is no credible exposure pathway for the Greater Bilby to ingest pit lake water.
<i>Dasyurus hallucatus</i> – Northern Quoll	Mineralised or saline pit lake water.	Residual PAF minerals in the pit walls, natural salinity of groundwater inflows.	Oxidation of PAF or mineralised pit walls and evapoconcentration of dissolved minerals over time resulting in a saline and potentially toxic source of water of low ecological value.	The pits are not located in Northern Quoll habitat. The Northern Quoll is not expected to be present. The pit lakes will have no ecological value and will not provide a viable foraging ground to the Northern Quoll. The depth and distance to water, steep walls and abandonment bunding will reduce accessibility to the pit lakes.	Initially, pit lake water will be fresh and non-toxic. Pit lake water will become saline in the long term. This is unpalatable and will be avoided by most species, including the Northern Quoll. If ingested, systemic toxicological impacts could occur affecting individuals rather than populations.	Rare	Minor	Low	A pit lake will not be present during operations.	NSR proposes to construct an abandonment bund around the pit at closure, while retaining the operational safety bund. These measures are expected to be effective at minimising access to the pit by the Northern Quoll.	Rare	Insignificant	Low	Pit lakes at closure will not provide suitable habitat or attract prey species in abundance, particularly given their increasing salinity and low ecological productivity. The species is unlikely to drink from, forage around, or den near pit lakes. There is no credible exposure pathway for the Northern Quoll.



Receptor (MNES Species)	Hazard	Source	Pathway	Exposure	Description of Impact	Likelihood	Consequence	Inherent Risk	Treatment / Management - Operations	Treatment / Management - Closure	Likelihood	Consequence	Residual Risk	Overall Risk
<i>Liasis olivaceus barroni</i> – Pilbara Olive Python	Mineralised or saline pit lake water.	Residual PAF minerals in the pit walls, natural salinity of groundwater inflows.	Oxidation of PAF or mineralised pit walls and evapoconcentration of dissolved minerals over time resulting in a saline and potentially toxic source of water of low ecological value.	The species is unlikely to frequent the pit area. Given the depth and distance to pit lake water, low ecological productivity, absent prey base and physical inaccessibility, the species is very unlikely to access the pit lakes. Pit lake water will become saline over time further reducing the likelihood of the species frequenting the pit lakes.	Initially, pit lake water will be fresh and non-toxic. Pit lake water will become saline in the long term and unpalatable and avoided by most species, including the Pilbara Olive Python. If ingested, systemic toxicological impacts could occur affecting individuals rather than populations.	Unlikely	Minor	Low	A pit lake will not be present during operations.	NSR proposes to construct an abandonment bund around the pit at closure, while retaining the operational safety bund. These measures are expected to further reduce the likelihood of the species frequenting the pit lake.	Rare	Insignificant	Low	Critical foraging and breeding habitat for the Pilbara Olive Python is 7.5 km from the pit lakes and would only be utilised as a dispersal habitat. This coupled with the inaccessibility of the pit lake, the limited ecological value, absence of prey and increasing salinity over time, there is no credible exposure pathway for the Pilbara Olive Python.
<i>Rhinonictis aurantia</i> – Pilbara Leaf-nosed Bat	Mineralised or saline pit lake water.	Residual PAF minerals in the pit walls, natural salinity of groundwater inflows.	Oxidation of PAF or mineralised pit walls and evapoconcentration of dissolved minerals over time resulting in a saline and potentially toxic source of water of low ecological value.	The Pilbara Leaf-nosed Bat is cave-roosting and forages primarily in gorge and riparian habitats where insect prey is abundant. Acoustic monitoring has confirmed occasional overflight of individuals within the Development Envelope, but no roosting habitat or high-quality foraging areas occur within the Project footprint. The depth to pit lake water, limited access points (shallow beaches) and low ecological productivity render the pit lake unattractive to the species.	Initially, pit lake water will be fresh and non-toxic. Pit lake water will become saline in the long term and unpalatable and avoided by most species, including the Pilbara Leaf-nosed Bat. If ingested, systemic toxicological impacts could occur affecting individuals rather than populations.	Unlikely	Minor	Low	A pit lake will not be present during operations.	The Pilbara Leaf-nosed bat is a volant species. Access restrictions that are effective for terrestrial fauna will not limit access to this species.	Unlikely	Minor	Low	A potential exposure pathway exists for the Pilbara Leaf-nosed Bat via drinking of pit lake water. However, the depth to pit lake water, limited access points and low ecological productivity of the system (absence of insects / prey) make such interactions improbable. Progressive salinisation will render the water unsuitable for drinking in the long term.,. Exposure to pit lake water is considered very unlikely for this species.



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