Rustlers Roost and Quest 29 Open-Cut Mine Redevelopment

Draft Environmental Impact Statement (EIS)

Section 7.1 - Terrestrial Environmental Quality

Prepared pursuant to the Environment Protection Act 2019

October 2021

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Document History and Status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
A	05/09/2021	P.Davey, T.Mitchell	P.Davey	05/09/2021	Draft
B	24/09/2021	S.Ley; T.Mitchell	P.Davey	30/09/2021	Draft
0	22/10/2021	P.Davey	P.Davey	22/10/2021	Final

Distribution of Copies

Version	Date issued	Quantity	Electronic	Issued to
Draft, Rev A	05/09/2021	1	Word	Primary Gold Ltd
Rev B	30/09/2021	1	Word	Primary Gold Ltd
Rev 0	22/10/2021	1	PDF	Primary Gold Ltd

Last Saved:	25 October 2021
File Name:	1001087_Rustlers-Roost-Quest-29-Draft EIS_Final_Oct 2021
Author:	CDM Smith
Project Manager:	Paul Davey
Client:	Primary Gold Ltd (PGO)
Document Title:	**Rustlers Roost and Quest 29 Open-Cut Mine Redevelopment: Draft Environmental Impacts Statement (EIS)**
Document Version:	Rev 0
Project Number:	1001087

Key Project Terms

Term	Definition
Adaptive Management	Systematic process for incrementally improving management practices by learning from the outcomes of past and current practices.
Carbon in Leach	This process uses a dilute alkaline cyanide solution to leach (dissolve) gold from the ore material. Activated carbon removes gold out of dilute cyanide solution by adsorption (sticking). The leaching agent and activated carbon are added together in a slurry of ore and water.
Development Envelope	Defined as the maximum area within which the Project footprint could occur. The development envelope for the Project encompasses 790 ha, inclusive of Rustlers Roost, Quest 29, the accommodation camp and haul road.
Environmental Aspect	An element of the Primary Gold's activities, products or services that can interact with the environment.
Environmental Impact	Change to the environment whether adverse or beneficial, wholly or partially resulting from the Primary Gold's environmental aspects. Environmental impacts can be caused directly or indirectly from a Project activity or cumulatively with other non-Project related activities in a set area.
Environmental Factor	The NT EPA listed environmental objectives to identify environmental matters that have value to the Northern Territory and that need to be protected; and to state the objective to be achieved for each matter. The NT EPA has prepared these environmental objectives and organised these in structured divisions of the environment, called environmental factors.
Existing Disturbance Footprint	Defined as the direct disturbance area from known historical activities associated with the Rustlers Roost, Quest 29, accommodation camp and haul road areas. For Rustlers Roost and Quest 29 this is taken from the existing Mine Management Plans. The existing direct disturbance footprint encompasses 169.4ha within the development envelope.
Heap Leach Pad	Existing areas where historic mining placed ore for processing via a leaching solution to dissolve and capture the mineral. The pads contain the remaining material.
Maximum Vegetation Clearing Extent	The maximum extent of native vegetation clearing proposed for the Project based on mapped vegetation extent layers which account for historic anthropogenic disturbances to the development envelope (e.g. historic mining and pastoral activities). This area constitutes a total of 368.86 ha.
Project	The Project includes the expansion of existing pits, waste rock landforms, water storage dams and internal roads in both the Rustlers Roost and Quest 29 MLs. Two new pits will be constructed at Rustlers Roost and new infrastructure includes an onsite processing plant, a tailings storage facility, a landfill, laydown area, magazine, administration office, accommodation camp and groundwater bores for water supply. The Project is inclusive of an expanded connecting haul road between the non-contiguous extraction areas and an accommodation camp.
Project Area	The Project area is defined as wholly including ML1083 (Rustlers Roost), ML 29783 (Quest 29), ML 29814 (accommodation camp) and the connecting haul road. The entire Project area covers 1,143.25 ha.
Direct Disturbance Footprint	Defined as the direct disturbance area based on the current proposed infrastructure and material placement inclusive of Rustlers Roost, Quest 29, the accommodation camp and haul road. This area covers both historically disturbed and undisturbed areas. The disturbance footprint encompasses 532.84 ha within the Project area.
Significant Impact	A significant impact of an action is an impact of major consequence having regard to: (a) the context and intensity of the impact; and (b) the sensitivity, value and quality of the environment impacted on and the duration, magnitude and geographic extent of the impact.
Study Area	Refers to the area of survey or investigation for a specific study. This area may be beyond the Project area or development envelope.
Tailings Storage Facility	A specially engineered and constructed impoundment into which tailings (residue) from the ore processing plant is deposited for placement in perpetuity. The storage facility is constructed with confining embankments consisting of earthen material (e.g. rock and soil) and capped following closure.
Waste Rock Dump	An engineered and constructed impoundment into which overburden from the mining process is placed for safe storage in perpetuity.

Acronyms, Abbreviations and Units

Abbreviation, Acronym or Unit	Definition
$m	Million dollars
%	Percentage
+ve	Assessment of positive
µS	Microsiemens
4WD	Four-wheel drive
AADT	Average Annual Daily Traffic
AAS	Atomic Absorption Spectrophotometer
AAPA	Aboriginal Areas Protection Authority
AARL	Anglo American Research Laboratory
ABS	Australian Bureau of Statistics
AE	Aquatic Ecosystems
AEP	Annual Exceedance Probability
AFANT	Amateur Fishermen's Association of the Northern Territory
AHD	Australian Height Datum
ALA	Atlas of Living Australia
ALARP	As Low As Reasonably Practicable
AMD	Acid and Metalliferous Drainage
ANC	Acid Neutralising Capacity
ANCOLD	Australian National Committee on Large Dams
ANFO	Ammonium Nitrate
ANZG	Australia and New Zealand Government
ARI	Average Recurrence Interval
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
AS	Australian Standard
ASRIS	Australian Soil Resource Information System
ASX	Australian Stock Exchange
AS/NZS	Australian/New Zealand Standards
AUSRIVAS	Australian River Assessment System
BESS	Battery Energy Storage System
BoM	Bureau of Meteorology
BOO	Build-Own-Operate
BOOT	Build-Own-Operate-Transfer
Bq	Becquerel
BUD	Beneficial Use Declaration
CAD	Computer-Aided Design
CAPEX	Capital Expenditure
CCTV	Closed Circuit Television
CE	Community and Economy
CEO	Chief Operating Officer
CH_4	Methane

Abbreviation, Acronym or Unit	Definition
CIL	Carbon in Leach
CO_2	Carbon Dioxide
CO_2-e	Carbon Dioxide Equivalent
COPC	Contaminant of Potential Concern
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSL	Compact Soil Liner
CSM	Conceptual Site Model
C&D	Construction and Demolition
C&I	Commercial and Industrial
DAWE	Department of Agriculture, Water and Environment (Cth) (current)
DEPWS	Department of Environment, Parks and Water Security (NT) (current)
DGV	Default Guideline Value
DIDO	Drive-in Drive-out
DITT	Department of Industry, Tourism and Trade (NT) (current)
DIWA	Directory of Important Wetlands of Australia
DO	Dissolved Oxygen
DotE	Department of the Environment (Cth) (former)
DotEE	Department of the Environment and Energy (Cth) (former)
EC	Electrical Conductivity
EH&S	Environment, Health and Safety
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMS	Environmental Management System
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
EP Act	*Environment Protection Act 2019*
ERA	Energy Resources of Australia
ERP	Emergency Response Plan
ESCP	Erosion and Sediment Control Plan
ESD	Ecologically Sustainable Development
GDE	Groundwater Dependent Ecosystem
GGAP	Greenhouse Gas Abatement Plan
GHG	Greenhouse Gas
GJ	Gigajoule
GL	Gigalitre (1,000 Megalitres)
GPS	Global Positioning System
GRP	Gross Regional Product
GST	Goods and Services Tax
g/t	Grams Per Tonne
GV	Guideline Value
GWP	Global Warming Potential
ha	Hectare

Abbreviation, Acronym or Unit	Definition
HDPE	High Density Polyethylene
HEC-HMS	Hydrologic Modelling System
HFC	Hydrofluorocarbons
HP	Hydrological Processes
HSE	Health, Safety and Environment
IAP2	International Association for Public Participation
IBC	Intermediate Bulk Container
ID	Identification
IECA	International Erosion Control Association
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Provider
ISO	International Organisation for Standardisation
IWEQ	Inland Water Environmental Quality
JORC	Joint Ore Reserve Committee
kL	Kilolitre
km	Kilometre
km^2	Square Kilometre
kV	Kilovolt
L	Litre
L/s	Litre Per Second
LED	Light Emitting Diode
LiDAR	Light Detection and Ranging
LNG	Liquefied Natural Gas
LOM	Life-of-Mine
LPG	Liquefied Petroleum Gas
M	Million
m	Metre
m^2	Metre squared
m^3	Cubic metre
mAHD	Metres Australian Height Datum
mBGL	Metres Below Ground Level
MCP	Mine Closure Plan
MEDLI	Model for Effluent Disposal Using Land
mg	Milligram
ML	Mining Lease (Granted)
MLA	Mining Lease Application
mm	Millimetre
MMP	Mining Management Plan
MNES	Matter of National Environmental Significance
MP	Management Plan
mRL	Metres Reduced Level
Mt	Million Tonnes

Abbreviation, Acronym or Unit	Definition
Mtpa	Million Tonnes Per Annum
MW	Megawatt
N_2O	Nitrous Oxide
NAF	Non-Acid Forming
NAPP	Net Acid Producing Potential
N/A	Not Applicable
NGER Act	*National Greenhouse Energy Reporting Act 2007*
NLC	Northern Land Council
NMD	Neutral Mine Drainage
NORM	Naturally Occurring Radioactive Material
NOI	Notice of Intent
NO_2	Nitrogen Dioxide
NSESD	National Strategy for Ecologically Sustainable Development
NT	Northern Territory
NTG	Northern Territory Government
NTU	Nephelometric Turbidity Unit
NT Act	*Native Title Act 1993*
NVIS	National Vegetation Information System
OPEX	Operational Expenditure
PAF	Potentially Acid Forming
PASS	Potential Acid Sulfate Soil
PER	Public Environmental Report
PET	Plecoptera, Ephemeroptera and Trichoptera
PFC	Perfluorocarbon
PGO	Primary Gold Limited, a wholly owned subsidiary of Hanking Australia Investment Pty Ltd
PMF	Probable Maximum Flood
PMLU	Post Mining Land Use
PMST	Protected Matter Search Tool
PPL	Perpetual Pastoral Lease
Q	Quarter
RL	Reduced Level
RMP	Risk Management Plan
RO	Reverse Osmosis
ROM	Run of Mine
RRMPL	Rustlers Roost Mining Pty Ltd
RSWL	Reduced Standing Water Level
SA	Statistical Area
SD	Saline Drainage
SDS	Safety Data Sheet
SEP	Stakeholder Engagement Plan
SEIFA	Socio-Economic Indexes for Areas
SF_6	Sulfur Hexafluoride
SGV	Site-Specific Guideline Value

Abbreviation, Acronym or Unit	Definition
SIGNAL	Stream Invertebrate Grade Number – Average Level
SoBS	Site of Botanical Significance
SoCS	Site of Conservation Significance
SSAN	Security Sensitive Ammonium Nitrate
SSC	State Suburb Code
SSTV	Site-Specific Trigger Values
STP	Sewage Treatment Plant
SWGs	Stock Water Drinking Guidelines
SWL	Standing Water Level
t	Tonne
TAMS	Territory Asset Management Services
TARP	Trigger Action Response Plan
TBD	To Be Determined
TE	Terrestrial Ecosystems
TEC	Threatened Ecological Community
TEQ	Terrestrial Environmental Quality
Th	Thorium
TN	Total Nitrogen
ToR	Terms of Reference
TP	Total Phosphorus
TPWC Act	*Territory Parks and Wildlife Conservation Act 1976*
TSF	Tailings Storage Facility
TSS	Total Suspended Solids
TSSC	Threatened Species Scientific Committee
U	Uranium
UC	Uncertain
V	Volt
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
WCD	Water Control District
WDL	Waste Discharge Licence
WMP	Water Management Plan
WONS	Weed of National Significance
WRD	Waste Rock Dump
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

Section 7 Key Environmental Factors

For each of the key environmental factors identified in Section 6.2, the following sections provide details of the current condition of the receiving environment and potential environmental impacts associated with the Project.

7.1 Terrestrial Environmental Quality

NT EPA Environmental Factor	Terrestrial Environmental Quality
NT EPA Environmental Objective	*To protect the quality and integrity of land and soils so that environmental values are supported and maintained". The objective recognises the fundamental link between soil and land quality and the protection of ecological and social values that good soil quality and intact landscape supports.*
Relevant Policy and Guidance	▪ NT EPA Environmental Factors and objectives: Environmental impact assessment general technical guidance (NT EPA 2021); ▪ Environmental impact assessment and environmental approval in the Northern Territory: Environmental impact assessment guidance (NT EPA 2020a); ▪ Northern Territory Contaminated Land Guideline (NT EPA 2017); ▪ Guidelines for Assessment of Impacts on Terrestrial Biodiversity (NT EPA 2013a); ▪ Land clearing guidelines: Northern Territory Planning Scheme (DENR 2020); ▪ Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory (as related to the proposed onsite landfill) (NT EPA 2013b); ▪ Guidance on Adaptive Management (NT EPA 2018); ▪ Environmental Assessment Guidelines. Acid and metalliferous drainage (NT EPA 2013c); ▪ The principles of ecologically sustainable development, including under Part 2, Division 1 of the Environmental Protect Act; ▪ The principles of qualitative risk management described in AS/NZS 31000:2009 Risk Management – Principles and Guidelines; and ▪ Tailings Managements: Leading Practice Sustainable Development Program for the Mining Industry (Australian Government 2016).

This section describes potential impacts that may occur to land and soil within the Project area and surroundings. Mine site rehabilitation and closure are also considered. In addition, mitigation measures and rehabilitation of previously disturbed soils and land are summarised in the draft Mine Closure Plan (Appendix J).

The most pertinent environmental values regarding the physical and chemical properties of the soil types are described, including the potential presence of contaminated soils and existing erosion in the Project area and surroundings. This also includes a description of existing land units relevant to the Project. Potential impacts and risk to the environmental quality of the soil and land are discussed and quantified. These potential impacts have been assessed in accordance with the risk assessment framework identified in Section 6. Furthermore, avoidance, mitigation and management of defined potential impacts are discussed to enhance or restore environmental quality during operation and closure. Proposed monitoring and reporting in accordance with current best practice procedures is provided, with a conclusion of the assessment of the significance of residual risk to the environmental factor.

7.1.1 Environmental Values

This section describes and maps the geology, land systems, soil types and land units in the Project area and surrounds. Refer 5.1.1 for a description of the geological setting as relevant to the Project.

7.1.1.1 Land Systems

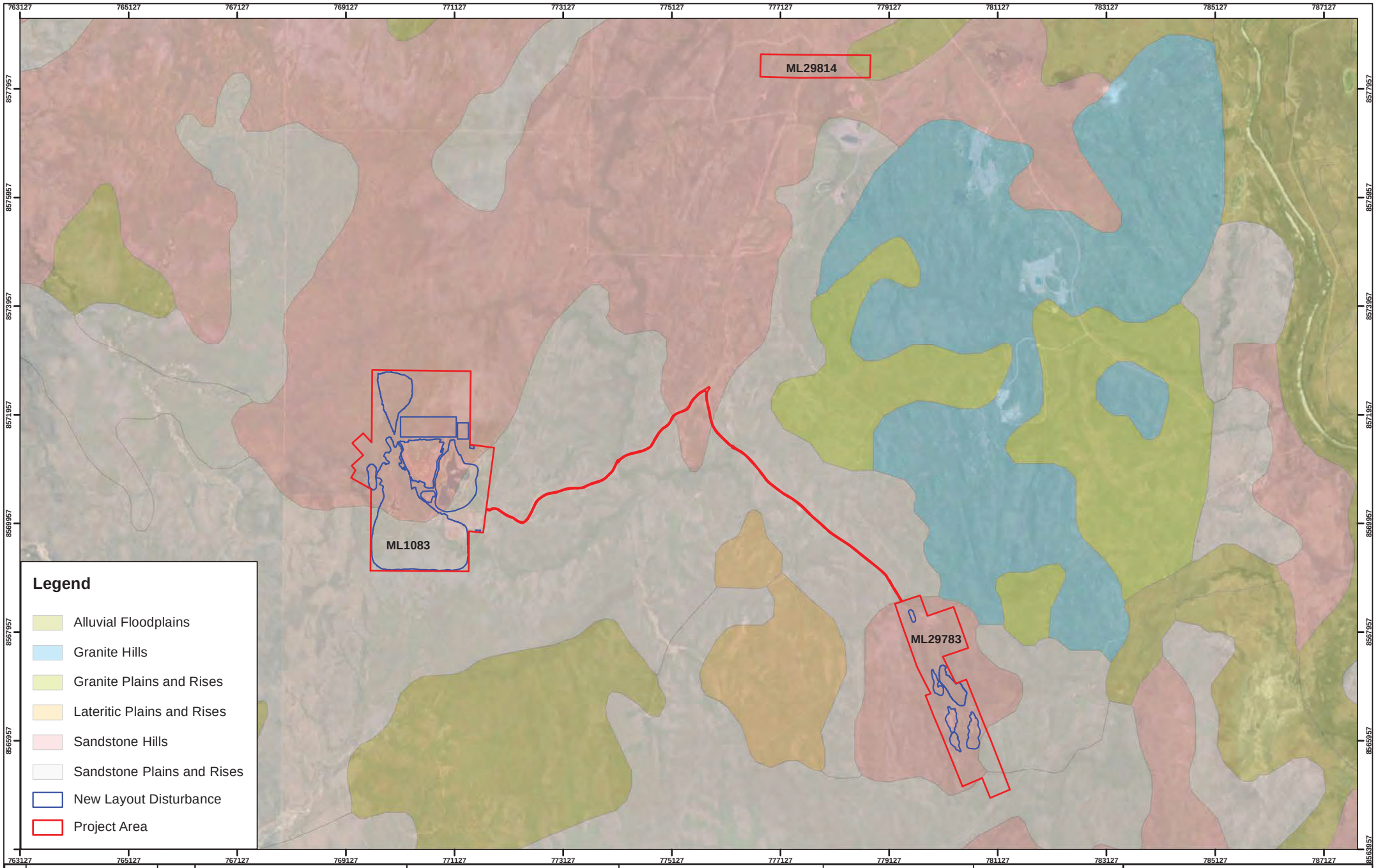
The Project is located in the Pine Creek bioregion. Land types in the Pine Creek bioregion typically consist of hilly to rugged ridges with undulating plains. Associated vegetation communities are eucalypt woodlands with patches of monsoonal forests. While more than 15% of the bioregion are within conservation areas, other major land uses are pastoralism, horticulture and mining activities (DAWE 2018). Data accessed from the Department of Environment, Parks and Water Security (DEPWS) online mapping database (NR Maps) (DEPWS 2021) for a desktop assessment identified three land systems present (Baker, Bend and Flatwood) within the Project area (Table 7-1), with the northern section of the Rustlers Roost Project area and most of the Quest 29 development envelope located within the Sandstone Hills land system class. The southern section of Rustlers Roost, the south-eastern portion of Quest 29 and most of the haul road Project area lies within Sandstone Plains and Rises land system class (Figure 7-1). Table 7-1 outlines the land systems, associated classes, landforms, and soils in more detail. Figure 7-2 shows the topography within the Rustlers Roost and Quest 29 areas.

Table 7-1 Predominant Land Systems in the Project Area

Land System	Class	Class Description	Landform	Soil Description	Soil Class
Baker (Bkr)	Sandstone hills	Low hills, hills and stony plateaux on sandstone, siltstone, quartzite and conglomerate (deeply weathered in places); outcrop with shallow stony soils	Rugged hills and strike ridges with intervening narrow valleys and short lower slopes on folded Burrells Creek greywacke, sandstone and siltstone	Skeletal soils and outcrop with minor sandy red and yellow gradational soils	Leptic Rudosols, shallow Yellow and Brown Kandosols
Bend (Bnd)	Sandstone plains and rises	Plains, rises and plateaux on mostly on sandstone, siltstone, claystone, shale, and some limestone; commonly shallow soils with surface stone and rock outcrop	Undulating low strike ridges and rises on folded Burrells Creek greywacke, sandstone, and siltstone	Skeletal soils and shallow gravelly loams	Shallow Yellow and Brown Kandosols and Leptic Rudosols
Flatwood (Flt)	Alluvial floodplains	Alluvial floodplains, swamps, drainage depressions and alluvial fans; sandy, silty and clay soils on Quaternary alluvium	Level to gently undulating alluvial floodplains of dominantly silty alluvium	Mottled yellow earths and duplex soils	Kandosolic and Chromosolic Hydrosols

The existing vegetation and extensive stone surface outcrops associated with these land systems provide land stability; however, land disturbed from clearing on slopes >2 % may result in increased surface water runoff velocities and consequently a higher erosion and sedimentation risk.

Mount Bundey, an area of outcropping granite, is a significant landform in the region located approximately 12 km north-east of Rustlers Roost and 7 km north of the Quest 29 MLs.



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Notes:

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Meters

1 cm = 628 meters

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FIGURE 7-1

Land Systems Relevant to the Project Area

DRG Ref: 1001087-EIS-07-7.1

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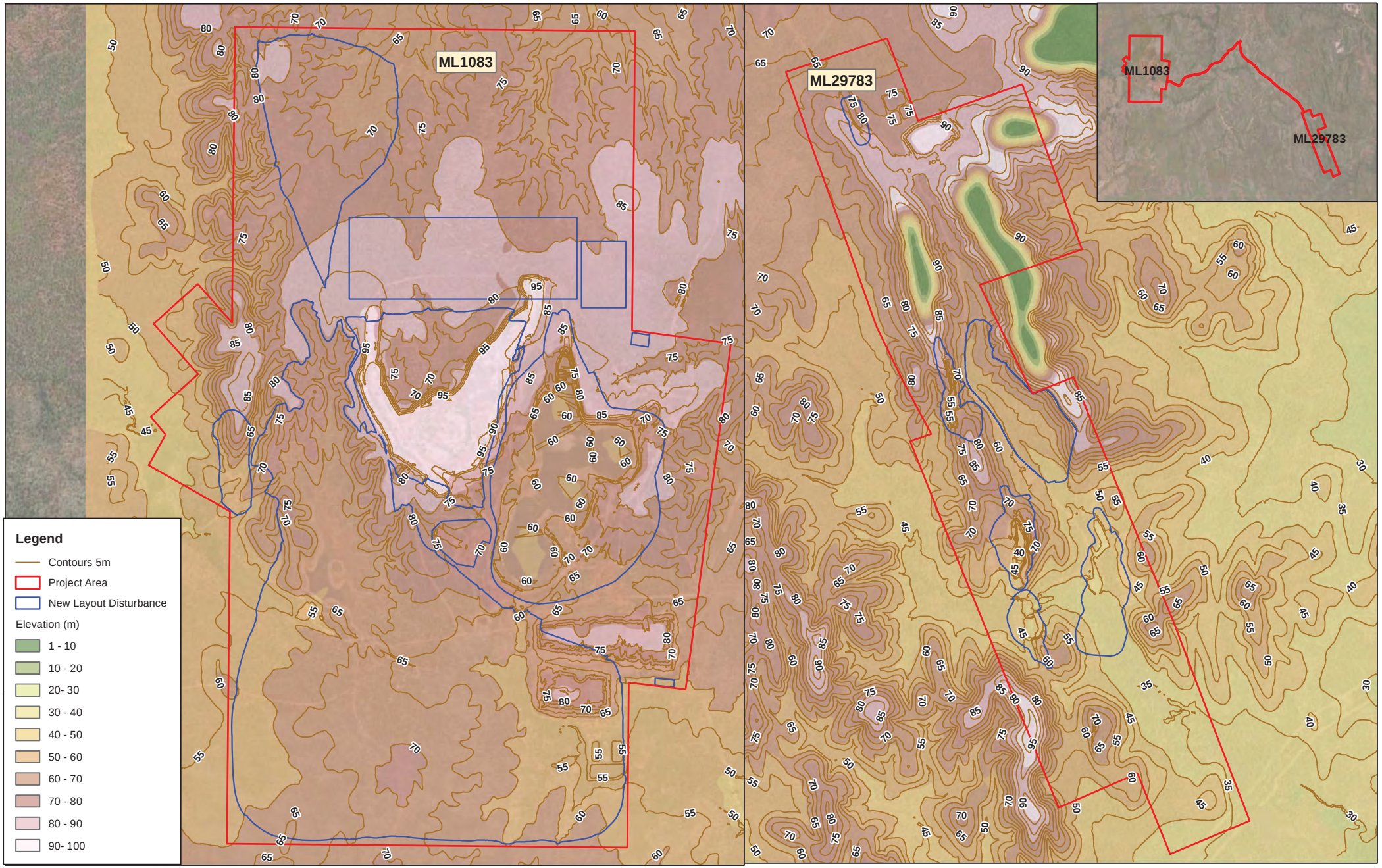

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FIGURE 7-2

Rustlers Roost and Quest 29
Topography / Elevation

DRG Ref: 1001087-EIS-07-7.4

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7.1.1.2 Soils

Overview

Information on the classifications of the soils within the Project area was retrieved from the Australian Soil Resource Information System (ASRIS) (2014). The desktop review of the available data has identified the following major soil types to occur within the Project area (Figure 7-3):

- LK22 – This soil type has been associated with hilly to steep hilly ranges and strike ridges mainly on greywacke, siltstones, and some sandstone. A surface stone cover is common with frequent rock outcrops. Chief soils of the hill slopes are shallow stony and gravelly loams and sand. Associated are variable areas of stony and gravelly soils. Most of the accommodation camp Project area and the entire Quest 29 Project area lies within LK22, but only a small north-western section of Rustlers Roost is associated with this soil type;

- Tb134 – These soils are found in strongly undulating to hilly lands on greywacke, siltstones, and sandstones with rock outcrops, and interspersed with gently sloping to flat-floored valleys of variable size and extent: soil dominance varies markedly between the valleys and the hilly portions. Chief soils of the basal hill slopes and the valleys are hard acidic and neutral, yellow mottled soils and usually in association with yellow and grey earths. Chief soils of the hill slopes are shallow stony and gravelly loams and sands in association with variable areas of stony and gravelly soils and yellow earths. The Rustlers Roost Project Area lies mostly within the Tb134 soil area; and

- Wd13 – Undulating to rolling and hilly terrain on granites; many rock outcrops and tors on crests and upper slopes: chief soils are sandy acidic yellow mottled soils on the undulating to rolling areas. Associated are podzolic soils containing ironstone gravels on gently undulating to flat portions, and gritty and gravelly sands and possible silicious sands on crests and upper slopes. The western side of the accommodation camp Project area lies within Wd13.

The main topsoils in this area are classified as Rudosols. Rudosols are characterised as shallow with minimal soil development and very high sand content (80-100%). Furthermore, these topsoils are acidic with a pH of between 4.3 – 4.9 and contain low organic carbon (<1%) (DLRM 2021). In addition, EcOz (2020a) identified Kandosols and Hydrosols within the Project area.

Kandosols are often referred to as red, yellow and brown earths. While these soils are normally massive and earthy, the Kandosols of the Project area are relatively shallow (< 0.5m). Furthermore, sand content is high between 60-80% with associated clay and silt content. Soil pH can be below 4.5 and organic carbon content < 1%.

Hydrosols are associated with natural drainage and creek lines, wetlands, and floodplains. They are seasonally inundated often supporting high environmental values. In the Project area Hydrosols are less than 0.5 m deep. Sand content is between 40-60%. pH can be slightly acidic to neutral and range between 5.7 to 7.0 and an organic carbon content of < 1%. Due to the seasonal water logging there is a potential ASS risk.

Erosion Risk

Erosion risk has been defined as the risk of mobilisation and transport of soil particles, mostly the fine and less dense particle fraction. This includes hummus and clay particles, both of which are important carriers of soil nutrients. Furthermore, these particles act as stabilising agents for the physical properties of soils. Therefore, erosion directly affects the ability of soils to maintain their ecological function that supports natural vegetation and landforms (Wantzen and Mol 2013). Erosion risk at the Rustlers Roost and Quest 29 Project area has been associated with land clearing, pastoral activities, existing disturbed soils from mining activities and the surface slopes gradient of the disturbed areas.

To investigate the erosion risk from existing disturbed area, soil samples were collected and analysed for soil erodibility (K-factor) and Emerson Class. The K-factor is a numerical representation of the ability of soils to resist the erosive energy of rain (IECA 2008) and is used in calculation of potential soil loss. The Emerson Class is determined from the Emerson Aggregate Test, an eight-class classification describing the behaviour of air-dried aggregates when placed in distilled water. Specifically, it describes whether the soil aggregates slake or disperse. Emerson class 1 and 2 have been associated with dispersion and high erosions risk and Emerson class 7 and 8 with low slaking, hence lower erosion risk. Table 7-2 shows the soil erodibility from selected soil samples from previously disturbed areas at Rustlers Roost and Quest 29. More detailed information is available in the ESCP (Appendix L).

Table 7-2 Soil Erodibility and Emerson Class from Collected Soil Samples in Disturbed Areas

Site	Location	Description	Soil Erodibility (K-factor)	Emerson Class
Quest 29				
Heap Leach Pad 1 and 2	779756 E 8568170 N	BHS Heap Leach pad.	0.03	Class 8
Heap Leach Pad 3	779755 E 8568187 N	BHS Heap Leach Pad.		
Zamu WRD 3 and 4	780759 E 8566164 N	Current Zamu WRD	0.024	Class 5
Rustlers Roost				
Rustlers Roost WRD 1	770589 E 8570700 N	Waste rock material southern area of the Rustlers Roost WRD.	0.017	Class 8
Rustlers Roost WRD 2	770458 E 8570832 N	Waste rock material southwestern area of the Rustlers Roost WRD.		
Rustlers Roost WRD 3	770458 E 8571168 N	Waste rock material southern area of the Rustlers Roost WRD		
Rustlers Roost Heap Leach Pad 1	770902 E 8570101 N	Gravel sized material from the northwest corner of the heap leach pad	0.012	Class 8

An erosion risk assessment conducted by Surface Water & Erosion Solutions (Appendix L) has shown that the surface slopes on the externally draining catchments range from effectively 0% to 55% with a mean of 5.3% in the Project area with a calculated mean soil loss rates of approximately 236 t/ha/y. In the analysis of surface slope (%) it was found that the majority of the Rustlers Roost site had surface slopes >0.75% and was classified as Class S3 – Class S5 regarding the erosion risk indicating that the soil landscapes have a moderate to very high risk of erosion. This confirmed the requirement for erosion and sedimentation control measures to be implemented during the operational and closure phase of the Project. The erosion risk categories of the classes are presented in Table 7-3 as an extract from the NT Land Suitability Guidelines (DLPE 2013).

Table 7-3 Erosion Risk and Corresponding Land Use Suitability Classes, Modified from NT Land Suitability Guidelines

Suitability Classes	Description	Drainage	Erosion Risk
Class S1 Highly Suitable	Land having no significant limitations to sustained application of a given land use, or only minor limitations. Nil to minor negative economic, environmental, health and/or social outcomes	Rapidly to Well	No runoff occurs
Class S2 Moderately Suitable	Land having limitations which in aggregate are moderately severe for sustained application of a given land use. Appreciably inferior to S1 land. Potential negative economic, environmental, health and/or social outcomes if not adequately managed.	Moderately-Well	<0.75% slope
Class S3 Marginally Suitable	Land having limitations which in aggregate are severe for sustained application of a given use. Moderate to high risk of negative economic, environmental, health and/or social outcomes if not adequately managed.	Imperfectly	0.75-5% slope, development will require best practice erosion and sediment control involving engineered works. On-going land management required
Class S4 Not Suitable	Land having limitations which may be insurmountable. Limitations are so severe as to preclude successful sustained use of the land in the given manner. Very high risk of negative economic, environmental and/or social outcomes if not managed.	Poor to very poor	5% slope, development will require considerable best practice erosion and sediment control involving a significant level of engineered works. High level of on-going land management essential
Class S5	Land having limitations which appear so severe as to preclude any possibilities of successful sustained use of the land in the given manner. Almost certain risk of significant negative economic environmental and/or social outcomes.	To be determined on assessment of specific cases	To be determined on assessment of specific cases. Environmental, social, health or economic risks are considered too high.

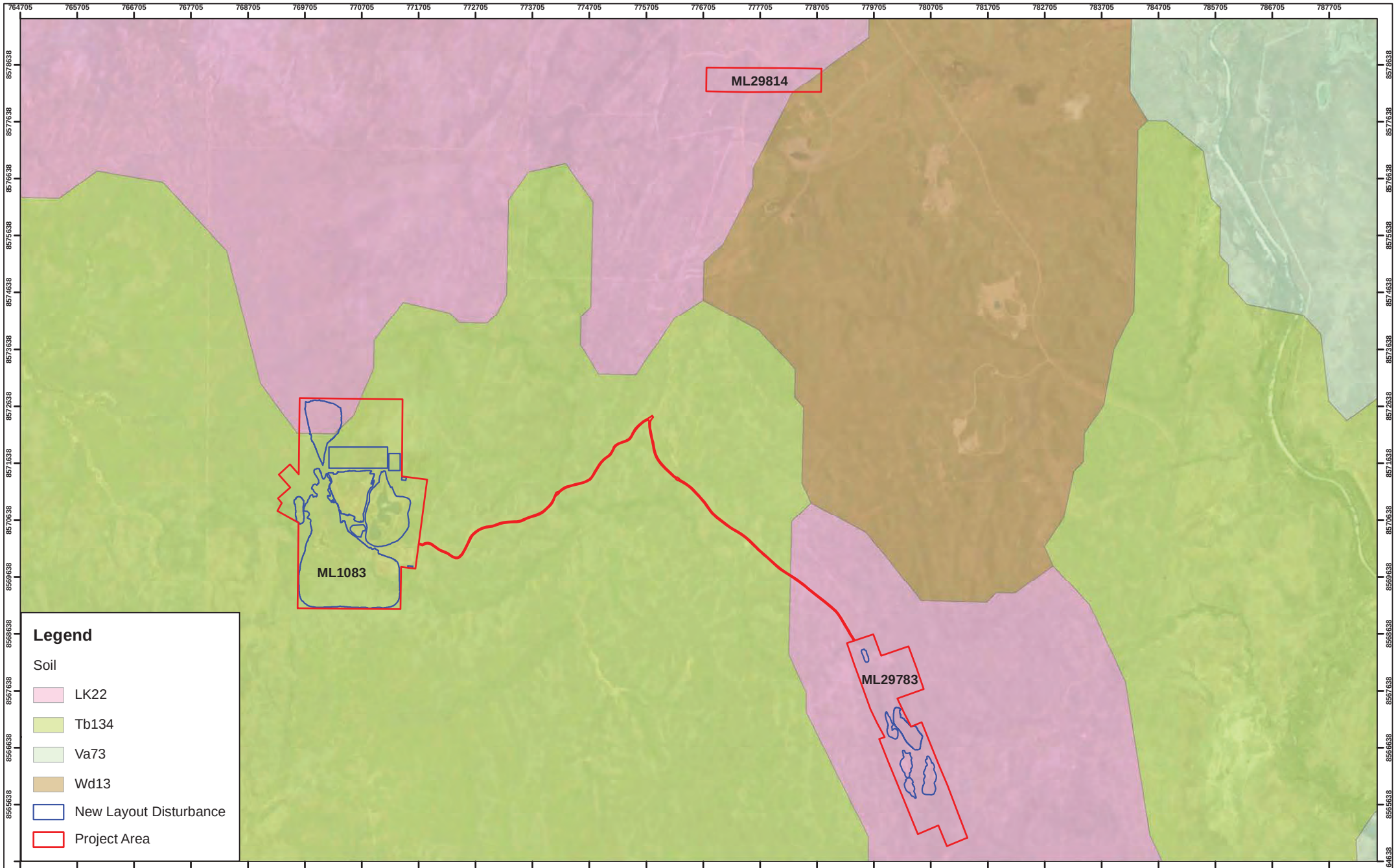

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FIGURE 7-3

Soils Types Relevant to the Project Area

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7.1.1.3 Land Units

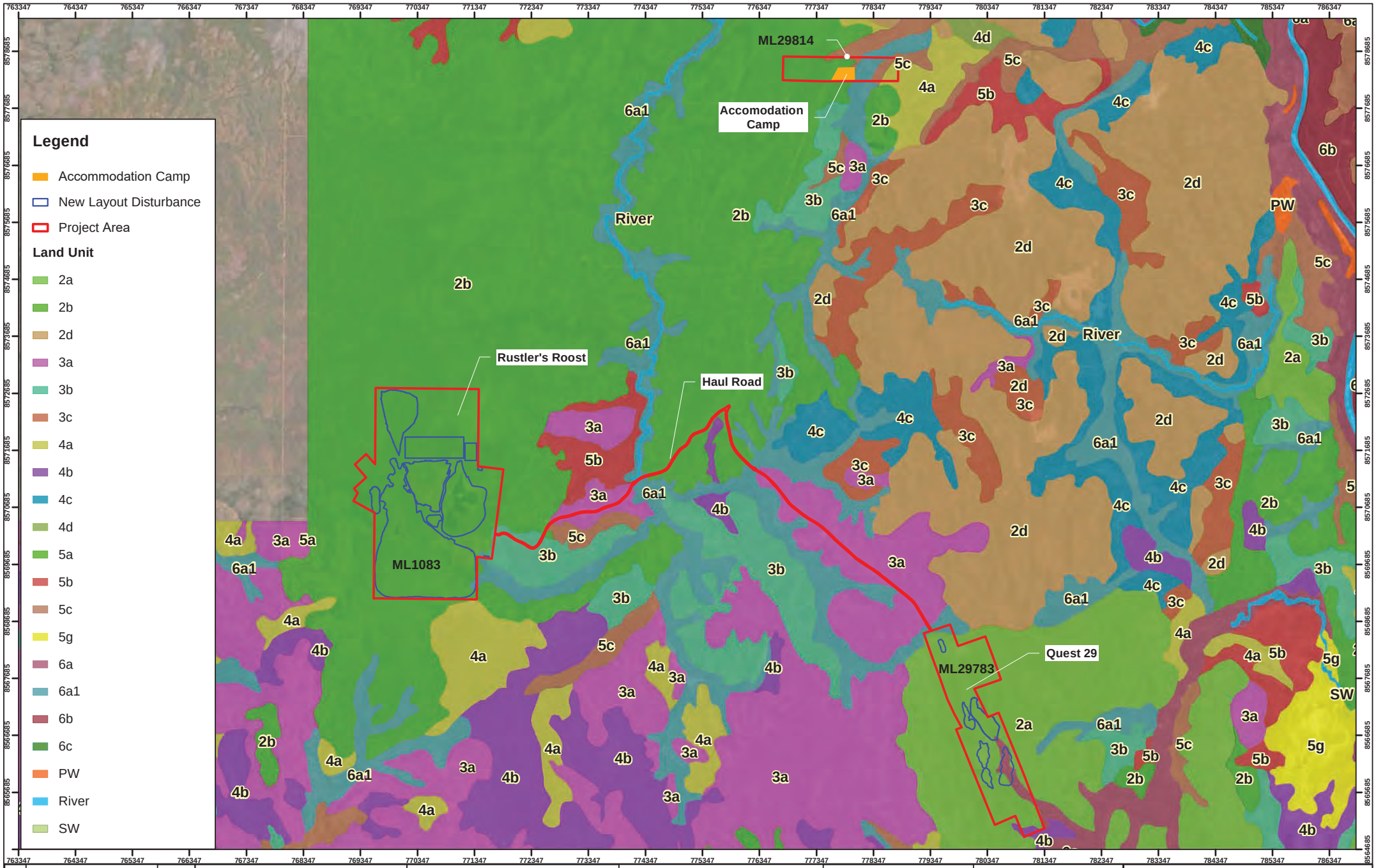
Land unit mapping of the Project area is available at a scale of 1:25,000 (Fett & Hall 1983). Land units relevant to Project area, inclusive of the Rustlers Roost, Quest 29, accommodation camp and haul road areas, are shown in Figure 7-4 and described in Table 7-4.

Table 7-4 Description of Land Units and Soils for the Project Area

Project Area	Land Unit	Landform Class	Landform Description	Soil	Soil Description	Vegetation Description
Quest 29	2a	Low hills	Rugged terrain associated with siltstones and greywacke of Burrells Creek formation and Upper Proterozoic dolomites and sandstones; relief 10-80m; slopes >10%; surface stone and outcrop extensive.	LK22 - Rudosols	Very shallow stony lithosols.	*Corymbia polysciada, Eucalyptus miniata, Corymbia dichromophloia* and *Erythrophleum chlorostachys* woodland/low open woodland with a *Chrysopogon fallax, Triodia bitextura, Heteropogon triticeus mixed sp*p. tussock grass understorey.
RustlersRoost, Accommodation Camp, Haul Road	2b	Rises	Low hills; ridges same lithologies as 2a; relief between 5-20m; slope gradients between 6-15%; extensive surface stone outcrop.	LK22 and Tb134 - Kandosols	Shallow stony and gravelly lithosols.	*Corymbia polysciada, Eucalyptus miniata, Corymbia dichromophloia* and *Erythrophleum chlorostachys* woodland/low open woodland with a *Chrysopogon fallax, Triodia bitextura, Heteropogon triticeus mixed spp*. tussock grass understorey.
Haul Road	3a	Rises	Low erosional rises, rounded crests and upper slopes <5%; 1-15m relief; occasional outcrop; 30-100% surface gravel.	LK22 and Tb134 - Kandosols	Gravelly yellow brown and yellow lithosols (Burrell 1 & 2) up to 1m deep overlying friable weathered siltstone and greywacke.	*Corymbia clavigera, Erythrophleum chlorostachys, Corymbia foelscheana* and *Calytrix spp*. low woodland; minor *Eucalyptus tectifica and Corymbia bleeseri* woodland; mixed spp. tussock grass understorey.

Project Area	Land Unit	Landform Class	Landform Description	Soil	Soil Description	Vegetation Description
RustlersRoost, Haul Road	3b	Low Rises	Erosional slopes, commonly below 3a, also below 2b and 2c; slopes <5%; 50-100% siltstone surface gravel.	Tb134 - Kandosols	Gravelly yellow brown and yellow lithosols (Burrell 1 & 2).	*Corymbia polysciada, Erythrophleum chlorostachys, Corymbia foelscheana* and *Calytrix spp*. low woodland. Minor *Eucalyptus miniata, Eucalyptus tectifica* and *Corymbia bleeseri* woodland.
Accommodation Camp	4a	Low Rises	Colluvial slopes below 3a and 3b; occasionally below 2b in southern areas; slopes <5%; up to 500m wide; relief 10m.	Wd13 - Kandosols	Shallow to moderately deep yellow earths (Battern 1); indistinct mottling in B horizon; scattered low termitaria.	*Erythrophleum chlorostachys, Eucalyptus miniata* mixed species woodland with *Sorghum plumosum, Themeda triandra, Chrysopogon fallax* and *Heteropogon triticeus* tussock grass understorey.
Quest 29	4b	Plains	Colluvial slopes below 3b and 4a above alluvial areas; slopes <2%; commonly 200m to 800m wide; relief <5m.	LK22 - Hydrosols	Moderately deep to deep yellow (Batten 1, Elliot 1 and 2); distinct mottling in sub-soil; minor debil debil; scattered large termitaria; waterlogged for short periods.	*Corymbia polycarpa, Corymbia grandifolia, Vitex glabrata* and *Lophostemon lactifluus* woodland with *Sorghum plumosum, Themeda triandra, Chrysopogon fallax* and *Eriachne burkittii* tussock grass understorey.
Haul Road	5b	Alluvial Plains	Alluvial plains up to 3km wide; negligible slope.	Tb134 - Hydrosols	Mottled yellow duplex (solodic) soils (Bundey, Keppler 1); shallow, hardsetting and pulverulent A horizon over a dense, mottled B horizon; well developed debil debil.	*Corymbia polycarpa, Corymbia bella and Corymbia grandifolia* open woodland/woodland; minor *Melaleuca spp.; Eriachne burkittii, Chrysopogon setifolius, Themeda triandra* mixed tussock grass understorey.

Project Area	Land Unit	Landform Class	Landform Description	Soil	Soil Description	Vegetation Description
Accommodation Camp, Haul Road	5c	Alluvial Plains	Alluvial plains up to 3km wide; negligible slope.	Tb134 and Wd13 - Hydrosols	Mottled yellow duplex (solodic) soils (Bundey, Keppler 1); shallow, hardsetting and pulverulent A horizon over a dense, mottled B horizon; well developed debil debil; minor grey non-cracking clays on Mary River floodplain.	*Eriachne burkittii, Chrysopogon setifolius* mixed spp. tussock grassland with sedges.
Quest 29	6a	Creek channel	Rivers and major creeks with associated narrow levees; channels incised up to 6m.	LK22 - Hydrosols	Alluvial yellow and red earths on levees; deep, gradational-textured profiles.	*Corymbia bella*, *Corymbia polycarpa, Ficus racemosa* and occasional *Melaleuca leucadendra, Alstonia actinophylla, Barringtonia acutangula and* Banyan trees mid high woodland to open forest, over *Erythrophleum chlorostachys*, *Terminalia* sp., and *Acacia auriculiformis* and occasional *Planchonia careya* open shrubland, over *Aristida* sp., and Hyptis mid high open tussock grassland.
Quest 29, RustlersRoost, Accommodation Camp, Haul Road	6a1	Drainage lines	Drainage lines in rugged terrain; narrow (<200m); normally incised to <2m.	LK22, Tb134 and Wd13 - Hydrosols	Yellow earths (Tortilla 2); moderately deep and usually sandy in upper reaches; weakly developed solodics (Bundey 1) in lower reaches towards major alluvials.	*Corymbia polycarpa, Corymbia grandifolia, Corymbia bella, Eucalyptus bigalerita* and *Melaleuca spp*. woodland/open forest with *Arundinella nepalensis, Eriachne burkittii, Mnesithea sp*. mixed species tussock grass understorey.



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Notes:

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0 650 1,300 2,600

Meters

1 cm = 599 meters

GCS GDA 1994 MGA Zone 52

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DATA SOURCE
NT Government Open Source Data

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FIGURE 7-4

Land Units Relevant to the Project Area

DRG Ref: 1001087-EIS-07-7.27

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7.1.1.4 Existing Disturbance and Contamination

Overview

Several areas within the Project area at both Rustlers Roost and Quest 29 had been previously cleared and have been highly modified and/or disturbed, and were classed as 'disturbance areas' rather than as a land unit. While disturbed areas contained established native flora species such as Acacias and Eucalypts; weeds such as the declared weed species Hyptis (*Hyptis suaveolens*), Mission Grass (*Cenchrus polystachios*) and Gamba Grass (*Andropogon gayanus*). Gamba Grass and Perennial Mission Grass are listed as Class B weeds under the NT *Weeds Management Act*, with Gamba Grass also listed as a Weed of National Significance (WoNS).

The Project area is located on pastoral land within Old Bundey Station and McKinlay River Pastoral Station. Grazing from freely roaming cattle has contributed to the degradation of vegetation and landforms and also led to localised erosion of creek beds mostly, nearby semi-permanent pools. Pigs and cattle have been commonly observed in the Project areas, mainly located around drainage channels and remaining pools at Quest 29.

Assessment of soil contamination from past land use and previous mining activities has to date been limited to waste rock and drainage lines. Contamination from hydrocarbon/chemical storage and use has not been assessed. Desktop review of previous geochemical characterisation studies and limited geochemical field assessment was undertaken at Rustlers Roost to assess the likelihood of AMD to be released from previously mined materials stored onsite (Appendix D). Ten surface samples were collected from the WRD and Heap Leach pads and two samples from the ROM pad, which were subject to geochemical analysis. All samples were classified as NAF. The report concluded, that for the waste materials currently stored on the surface, the potential for significant dissolved chemical loads to leach to surface or groundwater resulting in soil contamination is low.

Soil Properties of the Disturbed Areas

As previously mentioned, the National Soils Database ASRIS (2014) records a possible soil pH for the region surrounding the proposed site of less than 4.5 (Appendix D). Water-logged soils can contain iron sulfides and /or other sulfidic minerals that have not been oxidised. Potential acid sulfate soils (PASS) are normally saturated with water in the natural state. Existing acid sulfate soil (ASS) materials are benign when in a waterlogged state. However, when these soils or sediments are drained or excavated, and exposed to oxygen from the atmosphere, the oxygen reacts with the iron sulfides in the soil resulting in the production of sulfuric acid. This acidity releases elements such as metals and nutrients from the soil profile which can then be mobilised/transported to waterways, wetlands and groundwater systems, often with deleterious environmental and economic impacts (DER 2015). Only land unit 6a (Drainage Systems) has been described as containing water-logged soils within creek and drainage lines, therefore have the likelihood of PASS occurrence (Figure 7-3).

Mining activities and soil disturbance may result in acid drainage and/or metalliferous drainage (AMD). AMD originates when sulphide material is exposed to air and water. Metalliferous drainage can occur when acid is neutralised, but concentrations of some metals remain elevated at near neutral or alkaline conditions (Primary Gold 2020). In addition, the geochemical study (Appendix D) showed that the site geology is predominantly weathered material with regionally and locally acidic soils, likely caused by soluble and slightly soluble iron and aluminium oxide minerals in the weathered soil profile. These oxides provide a source of non-sulfur derived acidity. Reactions with Fe2+ can produce various forms of iron hydroxide precipitates (floc) e.g. goethite, depending on the pH of the system. The oxidation of Fe2+ and the hydrolysis of Fe3+ can liberate large amounts of acid often far down gradient from the source, and far more that than the oxidation of pyrite in conditions without free iron. It is noted that the release of acidity by hydrolysis can occur without the need for oxygen. Although there are several potential acid sources at the site, there are also minerals present in the soils and near surface geology that provide a source of neutralising potential, for the released acidity (Table 7-5). However, the measured low pH of the soils indicates the lack of availability of the in-situ neutralising potential. It is likely that these minerals are armoured by iron oxides in these superficial environments.

Table 7-5 Potential Acidity of Site Minerals

Potential Acid Forming Minerals at Site	Potential Acid Neutralising Minerals at Site
Pyrite	Calcium carbonate (calcite)
Arsenopyrite	Magnesium carbonate (dolomite)
Jarosite	Chlorite (silicate)
Alunite	Quartz (silicate)
Clays	Oxides and Clays

There is evidence of localised erosion within the previous mined area. For example, inspections and aerials surveys have recorded gully erosion of Rustlers Roost heap leach pad. However, existing berms prevented widespread sedimentation outside of the original heap leach pad footprint. Only at a small section in the south-eastern corner of the heap leach pad material was moved offside to a smaller extent due to a gap in the berm (refer to Plate 7-1 and Plate 7-2). The existing WRD and the leach pad at Rustlers Roost do not show any signs of significant erosion (refer to Plate 7-3). PGO has already established a photographic monitoring program to monitor the rate of the erosion and the transportation of materials away from the source over time in their 'Landform, Erosion and Sediment Control Environmental Management Plan' (Primary Gold 2016).

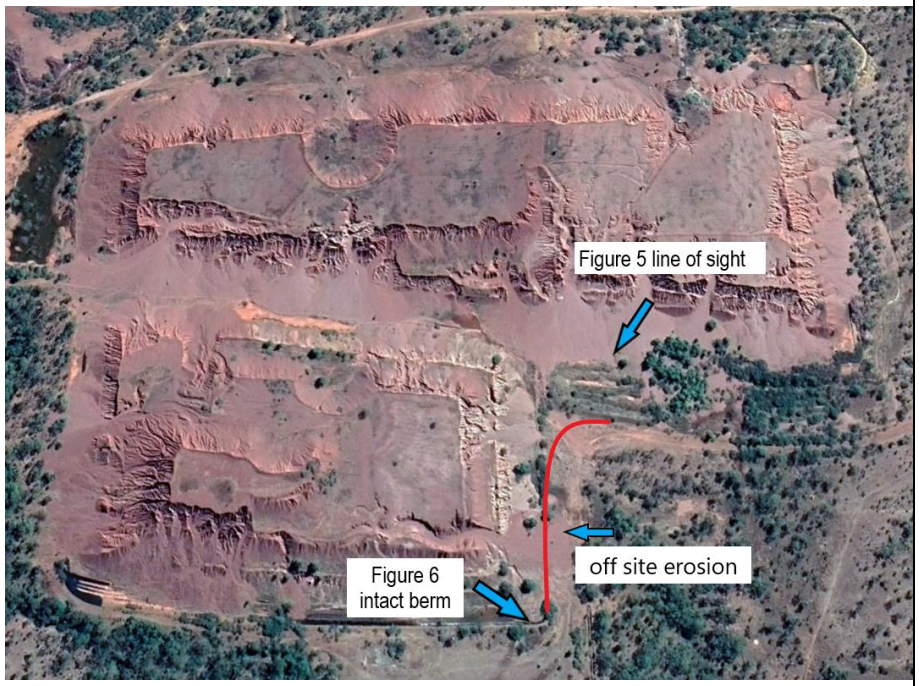
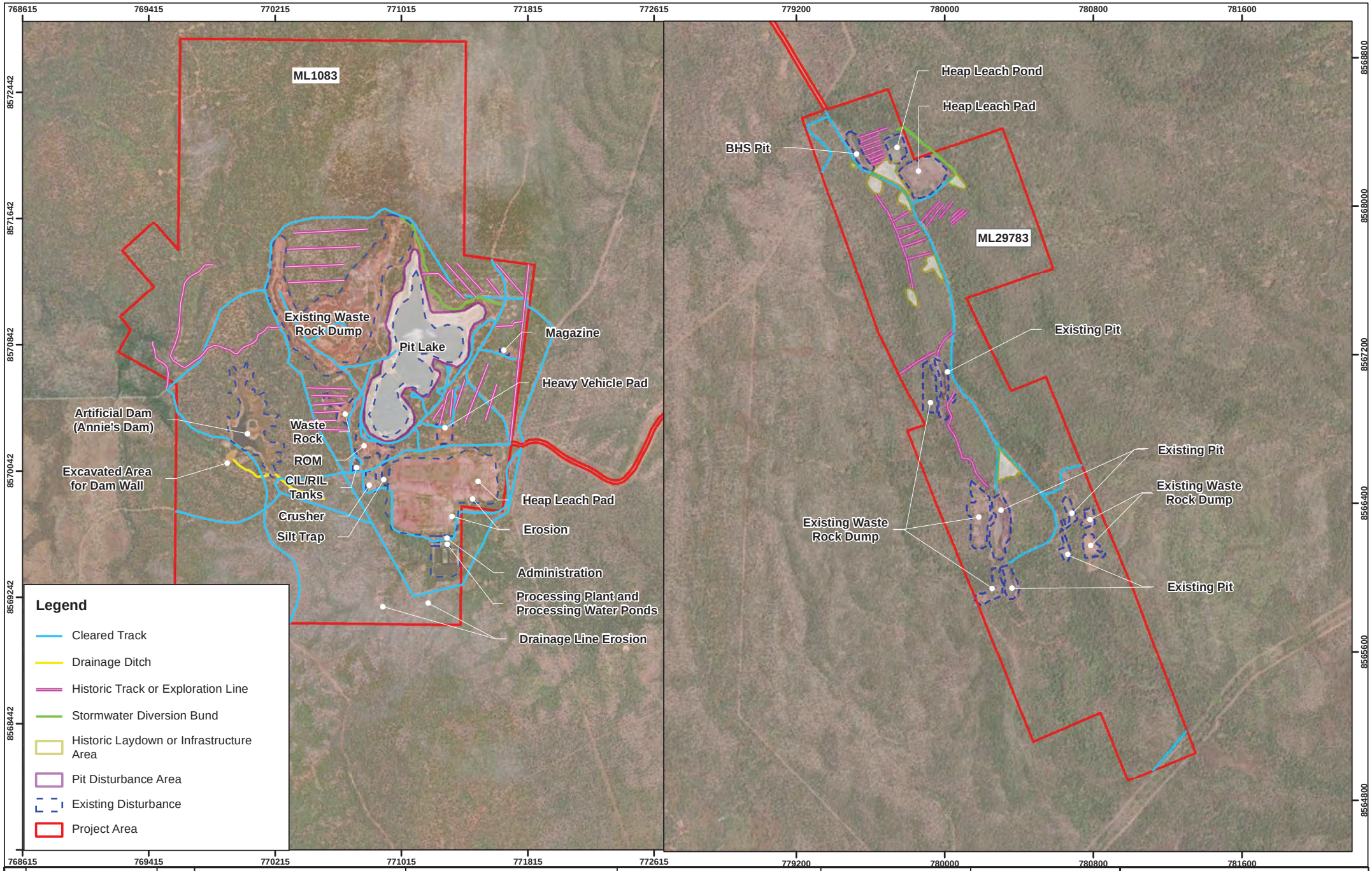


Plate 7-1 **Rustlers Roost Heap Leach Pad Erosion, Red Line Indicates Gap in Existing Berm**

Plate 7-2 **Rustlers Roost Heap Leach Pad Erosion**

Plate 7-3 **Rustlers Roost Heap Leach Pad, Intact Erosion Control Berm**

Approximately 31% of the Project area has been disturbed during previous mining activities and pastoral activities. This has resulted in topsoil removal and unrehabilitated legacy disturbance areas including the WRD at Rustlers Roost and the Heap Leach Pads at the Rustlers Roost and Quest 29 site. The existing disturbances in the Project area is shown in Figure 7-5.



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Notes:

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Meters

1 cm = 216 meters

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FIGURE 7-5

Existing Disturbance

DRG Ref: 1001087-EIS-07-7.33

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7.1.2 Potential Impacts and Risks

The identified impacts and risks have been assessed and are presented together with mitigations (where appropriate) in Section 6.3.4.2.

This section identifies, describes and assesses the potential impacts arising from the Project construction, operation and closure on the regional soils and landforms. The environmental risk assessment is discussed in Section 6 and presented in Appendix B identified and considered 11 potential sources of impact to the community and economic aspects. These were considered with regard to the potential to cause significant impacts and residual consequences.

Table 7-6 Potential Sources of Impact to Terrestrial Environmental Quality

Risk No.	Source of Impact	Project Phase(s)	Summary of Potential Impacts
TEQ-1	Vegetation clearing for the Project	Construction Operation	**Direct** - Disturbing an additional 333.4 ha of land for the Rustlers Roost, 26.16 ha for Quest 29, 7.3 ha for the accommodation camp, and 2 ha for the haul road (total of 368.68 ha). Direct disturbance has potential to result in destabilised soils. Potential soil erosion, loss of topsoil and sedimentation (through both water and wind erosive forces). Characteristics of soils, including chemical, physical, biological, and aesthetic qualities are degraded in the vegetation clearing areas. Resulting in less productive soils within the clearing areas and potential impacts to adjacent land from sedimentation. **Indirect or Cumulative** - Increased disturbance and loss of productivity of soils in the wider Mount Bundey locality coupled with disturbance at Toms Gully Mine and the nearby Mount Bundey Training Area. Resulting in reduced local capacity of soils to perform ecological functions and a cumulative increase in erosion contributing to dust and waterway sedimentation.
TEQ-2	Overtopping, embankment failure or seepage from the new TSF at Rustlers Roost leading to uncontrolled release of tailings material to surrounding environment.	Construction, Operation, Decommissioning, Closure	**Direct -** Contamination of surrounding land and alteration of soil characteristics, including chemical, physical, biological, and aesthetic qualities. Adversely affecting the biological processes that depend on soil quality (pyrite, pyrrhotite and arsenopyrite are expected to be present in tailings in quantities that will be Potentially Acid Forming). Impact on structural integrity of engineered embankments threatening additional failures and contaminant releases (e.g. adjacent decommissioned heap leach pad). **Indirect or Cumulative -** Potential transportation of contaminated sediments and material throughout the Project area and beyond. Biological and human health implications (primary contaminant of concern being cyanide). Groundwater pathways contributing to environmental contaminants mobilised in the surrounding environment through historic mining and quarrying activities. Potential for bioaccumulation of excessive contaminants. Potential for NORMS to present downstream ecological and human health risks.
TEQ-3	Overtopping, embankment failure or seepage from the process water storage at Rustlers Roost leading to	Operation, Decommissioning, Closure	**Direct -** Contamination of surrounding land and alteration of soil characteristics, including chemical, physical, biological, and aesthetic qualities. Adversely affecting the biological processes that depend on soil quality (pyrite, pyrrhotite and arsenopyrite are expected to be present in tailings in quantities that will be Potentially Acid Forming).

Risk No.	Source of Impact	Project Phase(s)	Summary of Potential Impacts
	uncontrolled release of process water to surrounding environment.		Impact on structural integrity of engineered embankments threatening additional failures and contaminant releases (e.g. adjacent decommissioned heap leach pad). **Indirect or Cumulative -** Potential transportation of contaminated sediments and material throughout the Project area and beyond. Biological and human health implications (primary contaminant of concern being cyanide). Contamination of downstream environments resulting in human health risks that would necessitate the closure of watercourse to extraction of drinking water, recreation, and fishing. Groundwater pathways contributing to environmental contaminants mobilised in the surrounding environment through historic mining and quarrying activities. Potential for bioaccumulation of excessive contaminants in environmental pathways should the same contaminants released from the nearby Toms Gully Mine or already present in the environment due to historic activities.
TEQ-4	Embankment failure of Annie's Dam water storage and uncontrolled water and sediment release.	Construction, Operation	**Direct -** Adverse impacts to Marrakai Creek and downstream aquatic ecosystems with movement and deposition of sediments and damage to vegetation and fauna downstream. Localised severe scouring of the topsoils in the area surrounding the breach and exposure of subsoils to erosive factors. Localised increase in Impact on structural integrity of engineered embankments. **Indirect or Cumulative** - Potential increase in cumulative concentration of sediments within the Marrakai Creek and Adelaide River as a result of any sediment discharged. Increased downstream depositions and siltation impacts. Also, indirect impact of reduced ability for successful revegetation due to loss of topsoils.
TEQ-5	Poor quality runoff or seepage from the historic WRDs and Heap Leaches.	Construction, Operation, Decommissioning, Closure	**Direct** - Contamination of soil and groundwater. Alteration of soil characteristics, including chemical, physical, biological, and aesthetic qualities. Potential direct species health impacts (reduced physical health or mortality). Inability of impacted soils to maintain biological qualities to support standard flora and fauna. **Indirect or Cumulative** - Potential transportation of contaminated sediments and material throughout the Project area and beyond. Biological and human health implications (primary contaminant of concern being cyanide). Contamination of downstream environments resulting in human health risks that would necessitate the closure of watercourse to extraction of drinking water, recreation and fishing. Groundwater pathways contributing to environmental contaminants mobilised in the surrounding environment through historic mining and quarrying activities. Potential for bioaccumulation of excessive contaminants in environmental pathways should the same contaminants released from the nearby Toms Gully Mine or already present in the environment due to historic activities.
TEQ-6	Geotechnical instability and failure	Construction, Operation,	**Direct -** Loss of ground stability in the surrounding wall failure resulting in movement and deposition of sediments and damage to vegetation and fauna habitat. Localised increase in

Risk No.	Source of Impact	Project Phase(s)	Summary of Potential Impacts
	of pit wall, TSF or WRD walls.	Decommissioning, Closure	groundwater levels. Impact on structural integrity of engineered embankments. Localised engulfment of flora and fauna. **Indirect or Cumulative** - Potential indirect ground or landform instability beyond the initial failure area (unlikely to be widespread).
TEQ-7	Indiscriminate use of existing waste rock for construction. Storage of waste rock outside of pit footprint for too long.	Construction, Operation, Decommissioning, Closure	**Direct** - AMD, heavy metals and NORMS leading to contamination of soils. Contamination of surrounding land and alteration of soil characteristics, including chemical, physical, biological, and aesthetic qualities. Adversely affecting the biological processes that depend on soil quality. **Indirect or Cumulative** - Potential transportation of leaching material, with potential to cause contamination, throughout the Project area and external. Indirect biological and human health implications in the immediate location of the placement and areas subject to seepage or runoff.
TEQ-8	Failure of process tanks/pipes/pumps.	Operation	**Direct** - Slurry or water release from process water circuit causing localised soil contamination or surface water contamination. Loss of native vegetation or habitat causing instability or soils and leading to erosion. **Indirect or Cumulative** - Potential increase in cumulative concentration of sediments within the Mount Bundey (Mary River) and Marrakai Creek (Adelaide River) catchment as a result of any sediment erosion indirectly caused by loss of vegetation from contamination. Increased downstream depositions and siltation impacts. Also, indirect impact of reduced ability for successful revegetation due to loss of topsoils and contamination of soils in the location of the spill.
TEQ-9	Erosion of site infrastructure leading to sedimentation	Operation, Decommissioning, Closure	**Direct** - Movement of soil or rock material from site infrastructure (e.g. WRD or TSF embankments) contributing to exposed surface and erosion, lack of vegetation, loss of topsoil, inability to re-establish vegetation. **Indirect or Cumulative** - Contribution to exposed ground in the Project area and general locality. Diminished complexity and biological integrity of Project area and soils. Potential indirect structural stability issues.
TEQ-10	Release of hazardous chemicals or materials during storage and handling onsite.	Construction, Operation, Decommissioning	**Direct** - Contamination of soil and alteration of soil characteristics, including chemical, physical, biological and aesthetic qualities. Adversely affecting the biological processes that depend on soil quality. **Indirect or Cumulative** - Indirect spread of chemicals throughout the environment through indiscriminate or unknown movement of soils (e.g. on vehicle tyres) or in downstream drainage line.
TEQ-11	Release of hazardous chemicals or materials during transportation to site.	Construction, Operation	**Direct -** Contamination of soil and alteration of soil characteristics, including chemical, physical, biological and aesthetic qualities. Adversely affecting the biological processes that depend on soil quality. **Indirect or Cumulative -** Indirect spread of chemicals throughout the environment through indiscriminate or unknown movement of soils (e.g. on vehicle tyres) or in downstream drainage line.

Risk No.	Source of Impact	Project Phase(s)	Summary of Potential Impacts
TEQ-12	Production of domestic waste and storage of the waste onsite	Construction, Operation, Decommissioning	**Direct** - Contamination of soil in the area proximal to the domestic waste receptacle where inappropriate storage vessels and management is used. Alteration of soil characteristics, including chemical, physical, biological and aesthetic qualities. Aesthetic qualities of the land are degraded. **Indirect or Cumulative** - Indirect spread of chemicals and/or living organisms (e.g. bacteria - E. coli) throughout the environment through indiscriminate or unknown movement of contaminated soils (e.g. on vehicle tyres or wind) or in downstream drainage line.
TEQ-13	Unfinished / unsuccessful rehabilitation of Project due to inadequate funds or natural disaster (e.g. cyclone).	Construction, Operation, Decommissioning, Closure	**Direct** - Site not rehabilitated to required standards. Increased potential for offsite impacts from AMD, erosion, and sedimentation. Degradation of land onsite and various forms of erosion (sheet, rill, wind etc.) transporting soils throughout the site and offsite. **Indirect or Cumulative** - Potential transportation of contaminated sediments and material throughout the Project area and beyond. Biological and human health implications (primary contaminant of concern being cyanide). Contamination of downstream environments resulting in human health risks that would necessitate the closure of watercourse to extraction of drinking water, recreation, and fishing. Given PGO is the same proponent for nearby the Toms Gully Mine project it would likely result in unfinished or unsuccessful rehabilitation at both sites. This would result in a large area of disturbed and unrehabilitated land in the Mount Bundey catchment cumulatively resulting in increased sediment loads to Mount Bundey Creek and the downstream Mary River.
TEQ-14	Inability to establish native vegetation by local provenance species with resultant cover comparable to nearby areas	Operation, Decommissioning, Closure	**Direct** - Completion criteria and environmental outcomes unable to be met. Potential soil erosion, loss of topsoil and sedimentation (through both water and wind erosive forces). Characteristics of soils, including chemical, physical, biological, and aesthetic qualities are degraded in the vegetation clearing area. Resulting in less productive soils within the disturbed areas and potential impacts to adjacent land from sedimentation. **Indirect or Cumulative** - Increased disturbance and lost productivity of soils in the wider Mount Bundey locality coupled with disturbance at Toms Gully Mine and the nearby Mount Bundey Training Area. Resulting in reduced local capacity of soils to perform ecological functions and a cumulative increase in erosion contributing to dust and waterway sedimentation.
TEQ-15	Lack of rehabilitation materials leads to inadequate tailings closure and poor-quality site rehabilitation.	Decommissioning, Closure	**Direct** - Completion criteria and environmental outcomes unable to be met. Potential soil erosion, loss of topsoil and sedimentation (through both water and wind erosive forces). Characteristics of soils, including chemical, physical, biological, and aesthetic qualities are degraded in the vegetation clearing areas. Resulting in less productive soils within the disturbed areas and potential impacts to adjacent land from sedimentation. **Indirect or Cumulative** - Increased disturbance and lost productivity of soils in the wider Mount Bundey locality coupled with disturbance at Toms Gully Mine and the nearby Mount

Risk No.	Source of Impact	Project Phase(s)	Summary of Potential Impacts
			Bundey Training Area. Resulting in reduced local capacity of soils to perform ecological functions and a cumulative increase in erosion contributing to dust and waterway sedimentation.
TEQ-16	Inappropriate management of the decommissioned site, post closure landform.	Closure	**Direct** - Unauthorised access to the site by externals (including public, leaseholders and livestock) negatively affecting rehabilitation. Potential soil erosion, loss of topsoil and sedimentation (through both water and wind erosive forces). **Indirect or Cumulative** - Increased disturbance and lost productivity of soils in the wider Mount Bundey locality coupled with disturbance at Toms Gully Mine and the nearby Mount Bundey Training Area. Resulting in reduced local capacity of soils to perform ecological functions, and potentially support current stocking densities and a cumulative increase in erosion contributing to dust and waterway sedimentation.
TEQ-17	Ineffective operational implementation of site environmental management system, plans and procedures.	Construction, Operation, Decommissioning, Closure	**Direct** - Environmental incidents causing degradation or enabling degradation of land and soils to occur unabated. Potential to result in degradation or contamination of soil and groundwater. Alteration of soil characteristics, including chemical, physical, biological and aesthetic qualities. Potential direct species health implications through reduced physical health or mortality. Reduced potential of impacted soils to maintain biological qualities to support standard flora and fauna. **Indirect or Cumulative** - Decreased likelihood of achieving rehabilitation goals and closure requirements following decommissioning. Agreed Post Mine Land Use (PMLU) cannot be achieved due to significant environment incidents resulting in widespread ongoing degradation of soils. Potential increase in sedimentation of downstream watercourse. Increased downstream depositions and siltation impacts. Indirect impact of reduced revegetation potential due to loss of topsoils.
TEQ-18	Use of Project machinery, equipment, vehicles, and activities causing fire through sparks or heat ignition source.	Construction, Operation, Decommissioning, Closure	**Direct** - Damage to topsoil composition and vegetation binding soils resulting in the increased erosion and dispersion. Potential contamination of soils due to fire extinguishers and material consumed by the fire. **Indirect or Cumulative** - Indirect loss of nutrients from topsoil dispersal and reduced viability of soils to re-establish vegetation, leading to potential introduction or spread of weeds. Potential increase in cumulative concentration of sediments within the downstream watercourse as a result of any sediment discharged. Increased downstream depositions and siltation impacts. Also, indirect impact of reduced ability for successful revegetation due to loss of topsoils.
TEQ-19	Dust generation from Project activities such as vehicular movements and earthworks.	Construction, Operation, Decommissioning Closure	**Direct** - Dust emission impacts on neighbours or the Arnhem Highway creating safety issues during operations. Loss of productive topsoil reducing rehabilitation potential. **Indirect or Cumulative** - Potential cumulative dust lift-off and deposition in the wider area in conjunction with Toms Gully Mine, nearby quarries, and the Mount Bundey Training Area. Potential increase in sedimentation of downstream watercourse as a result of any sediment discharged. Increased downstream

Risk No.	Source of Impact	Project Phase(s)	Summary of Potential Impacts
			deposition and siltation impacts. Indirect impact of reduced rehabilitation potential of topsoils.
TEQ-20	Inappropriate liquid and solid waste disposal.	Construction, Operation, Decommissioning Closure	**Direct -** Contamination of soil in the area proximal to the domestic waste receptacle where inappropriate storage vessels and management is used. Alteration of soil characteristics, including chemical, physical, biological, and aesthetic qualities. Aesthetic qualities of the land are degraded. **Indirect or Cumulative** - Indirect spread of chemicals and/or living organisms (e.g. bacteria - E. coli) throughout the environment through indiscriminate or unknown movement of contaminated soils (e.g. on vehicle tyres or wind) or in downstream drainage line.

Each of the above potential impacts are discussed in further detail in the subsequent sections, with some being grouped. Appendix B provides the comprehensive risk assessment, while Table 7-6 provides a summary of assessed inherent and residual impacts with consideration of measures applied in accordance with the environmental decision-making hierarchy.

The risk assessment identified several key themes of potential impacts to terrestrial environmental quality, namely, loss of biological function, potential for ground instability, erosion and sedimentation, land and soil degradation from contaminants, and change in landforms and potential for failure of rehabilitation. These are outlined below.

7.1.2.1 Loss of Soil Structure and Biological Function

Soil degradation caused by erosion has been identified as a prominent risk. Erosion affected soils are characterised by loss of productivity and quality impacting on existing floral biodiversity and promoting weed establishment, mobilisation of nutrients and contribution to greenhouse gas emissions (Lal 2001). The Project will result in additional clearing of 368.86 ha of vegetation. This will increase the disturbance footprint to 536.3 ha. Stockpiling of stripped topsoils plays a key role for successful rehabilitation outcomes as the soil contains essential seedbanks. However, there are risks that stockpile duration and physico-chemical soil characteristics may prevent successful utilisation of the natural seed stock for rehabilitation. For example stripped sodic soils may form crusting layers. Stockpiled soils may also have the potential for slaking, hard setting and erosion. Soil sampling prior to stripping will be conducted to determine local soil characteristics and to identify potential soil improvement actions during rehabilitation trials.

Inappropriate and/or longer-term storage of topsoils may cause degradation of seedbanks preventing successful natural revegetation of rehabilitated areas without supplementation from additional seed sources. Hence, management measures during stripping, stockpiling and storage of topsoils will be outlined in the draft MCP (Appendix J) and aim to maximise the viability of seedbanks to allow establishment of vegetation in the rehabilitated area(s). The rehabilitation trials will inform ongoing efforts and the requirement for additional reseeding with suitable local species.

The draft MCP will provide details on success criteria, monitoring and remediation methods to assure rehabilitation success and landform restoration.

7.1.2.2 Erosion and Sedimentation

Project area land classes are predominantly low hills to rises. While existing vegetation and extensive stone surface outcrops provide land stability, land disturbed on slopes >2 % may experience increased surface water runoff velocities resulting in a higher erosion risk. Change of landforms and clearing may lead to alteration of surface water flows and increased runoff leading to erosion during times of rainfall. Localised erosion at existing landforms has occurred mainly around the Rustlers Roost Heap Leach Pad (Primary Gold 2016).

The physical impacts of erosion from mining landforms are likely to be localised within the mining footprint and mostly associated with the slopes of the TSF and WRD wall structures during mining prior to rehabilitation. These potential impacts will be managed during the Project with specific design, timing and location of controls as outlined in the ESCP and associated engineering drawing (Appendix L). The ESCP recommends erosion and sediment control measures based upon the relationship between erosion hazard and erosion risk. The climate, with a reliable and prolonged dry season (May to September), provides a low risk of erosion from rainfall throughout these months, although wind erosion potential (dust) is a consideration. Therefore, it is essential that erosion and sediment control measures are fully implemented prior to October, in preparation for the wet season, and corresponding moderate to extreme erosion risk from October to April. Table 7-7 summarises the erosion risk associated with seasonal rainfalls.

Table 7-7 Annual Erosion Risk

Erosion Risk Rating	Monthly Rainfall (mm)	Period
Very low	0 to 30	May – Sept (Dry Season)
Moderate	45+ to 100	Oct and Apr
High	100+ to 225	Nov
Extreme	> 225	Dec - Mar

Infrastructure design will play a pivotal role in preventing erosion. The WRD, TSF and water storage dams will have appropriately designed slopes to prevent erosion during extreme rainfall conditions. For example, the potential TSF design and construction plan outlines a closure embankment slope of 3.5H:1V with 5 m horizontal benches at 10 m height increments (Knight Piesold 2021). Land-form erosion and instability post-closure can be caused by dispersion of waste material, unconsolidated tailings in the TSF, TSF and pit wall failure, inappropriate rehabilitation works and poor sedimentation control measures. The final Mine Closure Plan will address the mitigation of post-closure landform erosion and instability.

7.1.2.3 Soil and Land Contamination

Localised contamination of soils from spills and failure of infrastructure like processing pump, pipes and tanks could occur, as well as from storage and transport of chemicals and hydrocarbons on site. Table 7-8 lists the type and volume of hazardous chemical to be stored on site. Contamination of soils, and subsequent impacts to downstream surface water and groundwater quality, could occur if processing chemicals and hydrocarbons are not adequately stored, monitored and cleaned up in the event of a spill or leak.

Table 7-8 Hazardous Chemicals Stored on the Mine Site

Chemical	Volume / Amount
Cyanide	163 m^3
Hydrochloric Acid	70 m^3
Sodium Hydroxide	30 m^3
Copper Sulfate	10 m^3
Hydrogen Peroxide	16.7 m^3
Blanking agent (Diesel)	440 m^3
Quicklime	100 t
Flocculent	54.0 m^3
Liquid Petroleum Gas (LPG)	66 m^3
Smelting fluxes (main components)	4 t
Diesel Fuel	68,000 L

Waste rock and tailing material may contain high levels of metals like Aluminium, Arsenic, Copper, and Zinc which can be toxic particularly in aquatic environments. In the event that AMD is generated this may result in low pH and high metal loads mobilising into the environment causing soil contamination and degradation, if not appropriately managed.

Available geological, geochemical and water quality data suggests that for the legacy waste materials currently stored from historic mining activities, the potential for significant contaminant loads to leach to surface or groundwater and soils is low. Desktop and limited field studies were undertaken at Rustlers Roost to assess the likelihood of AMD to be released from previously mined materials stored onsite (Appendix D). Ten surface samples were collected from the WRD and heap leach pad and two samples from the ROM pad and geochemically analysed. All samples were classified as NAF, which is consistent with previous geochemical assessments of weathered materials within the geological profile. For example, results of waste characterisation work for Rustlers Roost undertaken by Graeme Campbell and Associates (CGA 1997) indicated that weathered waste material is classified as NAF and barren of sulfur, barren of sulfur with a negative net acid producing potential (NAPP). Total sulfur ranged from 0.02% to 0.13%. Arsenic in the waste material ranged up to 390 mg/kg, which is at the upper end of the range known to naturally occur in shales. Furthermore, post-processing ore material had a total sulfur range from 0.02% to 0.21% and was essentially barren to slightly positive NAPP, indicating small probability of AMD contamination. Arsenic levels to 416 mg/kg were noted and as with the waste material, is likely to be bound to clays in the leach material. Therefore, arsenic is not expected to be present in the spent ore leachate causing contamination to soils or land.

However, with progress of mining, exposure of more reactive materials from a deeper geological profile is likely to occur either by being raised to the surface or dewatered. This new reactivity may impact the quality of groundwater and surface water and result in contamination of soils and landforms with the catchment runoff. Geochemical assessments of legacy material indicated a correlation of increased mining depth and the increase in PAF material quantity (Appendix D). Currently, the base of the oxidation zone within Rustlers Roost is estimated as 60 m below the initial ground surface, with a proposed final pit depth for Rustler Roost at 175 m.

It is expected that further waste characterisation will confirm this correlation and that further mining will expose PAF material that will require management to prevent contamination of soils and landscapes. The preliminary geochemical assessment indicates that tailings from the Project (which will represent a composite of all lithologies at Rustlers Roost) are acid forming. The contaminants of potential concern (COPC) likely to be released from tailings include a suite of heavy metals (Ag, As, Al, Cd, Co, Cr, Cu, Fe, Mo, Ni, P, Pb, Se, Ti, U, V and Zn) and nitrate. In terms of management of the waste, ore and tailings at Rustlers Roost, any materials mined from within the transition zone and fresh zone of the deposit will be managed as PAF. The oxide zone is generally NAF, however, shales (Ss) within this zone may contain sufficient sulfide to present an acid generation risk.

Mined ore will be processed using a CIL processing method, which extracts gold from the ore by mixing with a cyanide solution. Tailings within the processing circuit, will be screened to recover carbon and then will go through a detoxification to remove residual cyanide. The recovered carbon and residual cyanide will be reused in the processing circuit. The potential toxicity of cyanide to biota in terrestrial and aquatic ecosystems has been identified as one of the key challenges for the gold mining industries. Excess cyanide from gold extraction may result in complexation with copper, iron and zinc and reacts with sulfur species to form thiocyanate (Australian Government 2008). While the residual cyanide in the tailings pond after the recycling process is subjected to natural degradation processes the potential for residual cyanide and cyanide metal complexes in the TSF and the process water pond could impact on downstream terrestrial and aquatic ecosystems, with potential contamination of soils, during an uncontrolled release event.

Overtopping, embankment failure or seepage from the process water pond adjacent to the processing plant at Rustlers Roost may lead to uncontrolled release of process water to the surrounding environment causing erosion and sedimentation. Furthermore, contamination of soils and landscapes could also occur as a result of TSF wall failure resulting in uncontrolled release of significant amounts of tailing materials. PAF material and heavy metals are expected to be present in tailings and may adversely affect biological processes depending on soil quality in the surrounding environment outside the Rustlers Roost and Quest 29 Project area.

In addition, impacts on structural integrity of engineered embankments from the adjacent decommissioned heap leach pad may pose the risk of additional failures and contaminant releases.

Contamination may occur from untreated sewage and waste produced by ablution blocks and accommodation camp facilities if subject to an uncontrolled release. The accommodation camp will be located adjacent to the Toms Gully Mine, contamination of soils and landforms from sewage (grey or back water) spills is possible for this area. Furthermore, overapplication of the treated effluent through irrigation could result in ground and surface water contamination with nutrients and potential pathogens especially during the wet season.

Overall, potential contamination of soils is likely to occur if problematic waste materials and the landforms they are stored in are not properly designed and managed during operations and post-closure. Further degradation of land on- and offsite with ongoing contamination may occur during or after site closure caused by inadequate rehabilitation. In addition, success of rehabilitation efforts may be impaired due to the loss of topsoils and contaminants in rehabilitation areas.

7.1.2.4 Rehabilitation Failure

Failure to provide for adequate rehabilitation of mine sites may result in long-term instability of the landforms, soils and hydrology of the site, permanent damage of ecosystem capacity to provide habitat for biota and services for people, pollution of the surrounding environment from previous mining activities and the introduction and the spread of weeds. Furthermore, inadequate rehabilitation may lead to reputational damage among regulators, stakeholder, and the wider community, resulting in future project approval delays, more restrictive permit/ licence conditions and loss of the company's social licence to operate. Finally, inadequate rehabilitation may result in a shift of cost and responsibility to the public sector and associated governmental authorities. A historical example for legacy issues related to

rehabilitation is the Rum Jungle mine, a former uranium and copper mine site about 100 km south of Darwin. While the site has been initially rehabilitated in the 1980s it requires ongoing restoration and rehabilitation work mostly funded by Commonwealth and the NT Governments (NT Government 2018).

7.1.2.5 Cumulative Impacts

There are four active extractive industry operations and one approved, but not yet active, mining operation in proximity to the Project. The construction and operation of the Project has the potential to incrementally contribute to fragmentation of landforms and disruption of soil properties in a cumulative context and temporary displacement of biota.

To address the ToR requirement for this Draft EIS, an assessment of the cumulative impacts of the Project across four spatial scales has been conducted. The spatial scales of consideration are:

- Property – defined as Mount Bundey Station and McKinlay River Station;
- Catchment – defined as the Mount Bundey Creek catchment, Marrakai Creek catchment and McKinlay River catchment;
- Region – defined as the Marrakai-Douglas Daly unincorporated area; and
- Bioregion – defined as the Pine Creek bioregion.

The cumulative impact assessment has considered the effects of multiple actions or impacts on the terrestrial environmental quality, including landforms (refer Table 7-9).

Table 7-9 Assessment of Cumulative Impacts to Terrestrial Environmental Quality

Project	Spatial Extent				Approx. Distance from Project	Impact Details	Reference
	Property	Catchment	Region	Bioregion			
Toms Gully Mine	✓	✓	✓	✓	0 km	Native vegetation and fauna habitat loss = 76 ha Cumulative loss of landform and soils supporting native vegetation of local provenance. Increased erosion risk with slopes > 2% on site. Erosion and sedimentation may affect Mount Bundey Creek catchment.	NT EPA 2020b GHD 2018
Boral Quarry	✓	✓	✓	✓	700 m	Approximately 35 ha of disturbance (including access road of 2.5) Cumulative loss of landform and soils supporting native vegetation of local provenance. Increased erosion risk with slopes > 2% on site. Erosion and sedimentation may affect Mary River floodplain.	NR Maps spatial mapping (DEPWS 2021)
HB Quarry	✓	✓	✓	✓	2 km	Approximately 47.5 ha of disturbance. Cumulative loss of landform and soils supporting native vegetation of local provenance. Increased erosion risk with slopes > 2% on site. Erosion and sedimentation may affect Mary River floodplain.	NR Maps spatial mapping tool (DEPWS 2021)
McKinlay Quarry	✓	✓	✓	✓	3.5 km	Approximately 17.5 ha of disturbance (including access road of 3 km) Cumulative loss of landform and soils supporting native vegetation of local provenance from clearing. Increased erosion risk with slopes > 2% on site and sedimentation that may affect Mary River floodplain.	NR Maps spatial mapping tool (DEPWS 2021)
Ostojic Quarry	✓	✓	✓	✓	4.4 km	Approximately 47.5 ha of disturbance. Cumulative loss of landform and soils supporting native vegetation of local provenance. Increased erosion risk with slopes > 2% on site. Erosion and sedimentation may affect Mary River floodplain.	NR Maps spatial mapping tool (DEPWS 2021)
Mount Bundey Military Training Area			✓	✓	9 km	The Mount Bundey Training Area is a 117,300 ha. No publicly available data No more than 10 ha of disturbance.	NR Maps spatial mapping tool (DEPWS 2021)
Woolwonga Mine				✓	47 km	Cumulative loss of landform and soils supporting native vegetation of local provenance.	NR Maps spatial mapping tool (DEPWS 2021)
Hayes Creek Mine				✓	58 km	Native vegetation and fauna habitat loss = 33 ha (consisting of Eucalyptus woodland on sandstone plains and Eucalyptus woodland on low sandstone hills and rises). Cumulative loss of landform and soils supporting native vegetation of local provenance.	NR Maps spatial mapping tool (DEPWS 2021) LES 2017
Union Reefs Gold Mine				✓	60 km	Clearing of regrowth vegetation required = 1 ha Cumulative loss of landform and soils supporting native vegetation of local provenance.	NR Maps spatial mapping tool (DEPWS 2021) NT EPA 2020c

Project	Spatial Extent				Approx. Distance from Project	Impact Details	Reference
	Property	Catchment	Region	Bioregion			
Frances Creek Iron Ore Mine				✓	75 km	Clearing of approximately 172 hectares of native vegetation, of which 78 hectares has been previously disturbed (open eucalypt woodland over grassland). Cumulative loss of landform and soils supporting native vegetation of local provenance.	NR Maps spatial mapping tool (DEPWS 2021) MBS Environmental 2006
Finnis Lithium Mine					80 km	Native vegetation and fauna habitat loss = 100.9 ha None of the vegetation types are rare or threatened. Disturbance will occur in land unit 1b and 5a, which supports Eucalyptus woodland, open woodland vegetation communities and poorly drained shrublands. Cumulative loss of landform and soils supporting native vegetation of local provenance.	NR Maps spatial mapping tool (DEPWS 2021) EcOz 2020b
Fountain Head Gold Mine				✓	90 km	Native vegetation and fauna habitat loss = 80.6 ha (eucalyptus woodland) Cumulative loss of landform and soils supporting native vegetation of local provenance.	NR Maps spatial mapping tool (DEPWS 2021) ERIAS 2021
Jabiru Hybrid Power Station				✓	140 km	Project area of 20 ha with 16.03 ha of disturbance. Cumulative loss of landform and soils supporting native vegetation of local provenance.	NR Maps spatial mapping tool (DEPWS 2021) CDM Smith 2021

Cumulative effects from erosion/ sedimentation and contamination may occur from the existing unrehabilitated WRD at Rustlers Roost site and heap leach ponds at the Rustlers Roost and Quest 29 from legacy mining activities. In addition, ongoing uncontrolled leaching of contaminants via surface flows into the landscape may result in accumulation in the affected soils.

Furthermore, Toms Gully Mine underground mine site is partially hydrologically connected to the Rustlers Roost and Quest 29 Project with drainage lines discharging into Mount Bundey Creek. This may result in cumulative effects on soils in floodplain areas downstream from both activities.

7.1.3 Avoidance, Mitigation and Management

Table 7-10 presents the strategy of a hierarchical approach of avoidance, mitigation and management to minimise potential impacts to the environmental values of terrestrial ecosystem quality.

Table 7-10 Avoidance, Mitigation and Management Measures

Potential Consequences	Measures
Loss of biological, physical, chemical and aesthetic function in soils affected by clearing	**Avoid** ▪ Only clearing the practical minimum footprint necessary for the portion of the Project to be implemented ▪ Clearly mark limits of clearing ▪ Make use of already disturbed areas where possible ▪ Avoid land clearing during December to March portion of the wet season **Mitigation and Management** ▪ Adherence to Ground Disturbance Procedures ▪ Implement erosion and sediment controls in accordance with an ESCP ▪ Implementation of Biodiversity Management Plan ▪ Implementation of Acid and Metalliferous Drainage Management Plan (AMDMP) and Water Management Plan (WMP) ▪ Progressive rehabilitation ▪ Adhere to buffer widths recommended by the Northern Territory Land Clearing Guidelines with regard to riparian vegetation in drainage lines ▪ Clearing and Topsoil Procedures Implementation ▪ Corporate commitment to EMS implementation via policy ▪ Environmental Management System and various management plans (e.g. EMP, WMP, MMP) **Rehabilitation** ▪ Monitoring and active rehabilitation of disturbed soils and landscapes ▪ Implementation of detailed Mine Closure Plan ▪ Review options for WRD Rehabilitation ▪ Financial provisioning for closure and rehabilitation implementation ▪ Recover topsoil from TSF, WRD and processing plant footprints
Contamination of surrounding land and soils from chemicals and hydrocarbons spills	**Avoid** ▪ Design, storage and handling of hazardous materials to Australian Standards and regulations ▪ Specific adherence of the ANFO storage to *Dangerous Goods Act 1998* and the NT *Work Health and Safety (National Uniform Legislation) Act 2011* ▪ Chemical and hydrocarbon storage and processing within containment bunding ▪ Pipelines, pumps, and tanks selected for appropriate capacity ▪ Pumps operated in accordance with supplier specification and operating manuals ▪ Drainage to processing plant area sump to prevent contaminant export ▪ Maintenance of relevant infrastructure as per manufacture scheduled recommendations ▪ Weekly inspections of storage areas, tanks and containers for structural integrity and leaks

	▪ Cyanide management and storage will be aligned to the Commonwealth of Australia Leading Practice Handbook for Sustainable Mining - Cyanide Management (Australian Government 2008) ▪ Chemical storage will be located a minimum 30 m from any drainage line or watercourse ▪ Standard pre-requirements for contractors for transport on site (must meet standard requirements and licencing) ▪ Appropriate site access for large vehicles ▪ All external operators to complete induction that includes transportation safety considerations **Mitigation and Management** ▪ Develop Emergency Response Plan and include in inductions ▪ Spill kits available around the site and procedures and training for the cleaning up of hazardous spills ▪ Implementation of hazardous materials management plan training for emergency response ▪ Emergency Management and Response Plan, spill response for transport incidents on site ▪ Implementation of WMP ▪ Implementation of Biodiversity Management Plan ▪ Implement erosion and sediment controls in accordance with an ESCP ▪ Cyanide management and storage will be aligned to the Commonwealth of Australia Leading Practice Handbook for Sustainable Mining - Cyanide Management (Australian Government 2008). ▪ Compliance with the WDL ▪ Manage disposal of wastes in accordance with the Project EMP (including bunded waste oil bins) ▪ Contaminant transport modelling further refined **Rehabilitation** ▪ Implementation of detailed Mine Closure Plan ▪ Review options for WRD Rehabilitation ▪ Financial provisioning for closure and rehabilitation implementation
Run-off, discharge of contaminants (AMD, metals, NORMS) altering soil quality	**Avoid** ▪ Make use of already disturbed areas where possible ▪ Clearly mark limits of clearing ▪ Adhere to buffer widths recommended by the Northern Territory Land Clearing Guidelines with regard to riparian vegetation in drainage lines ▪ TSF to be planned, designed, constructed and operated in accordance with approaches details in the guideline Tailings Management: Leading Practice Sustainable Development Program for the Mining Industry (Australian Government 2016) ▪ Design TSF to contain a range of design storm and rainfall sequences events up to and greater than the required design criteria ▪ Development of Monitoring Plan / Operational Manual which includes weekly inspections of the TSF, survey pins to monitor the embankment and piezometers to measure pore water pressure ▪ Install seepage control and underground drainage including a cut-off trench, compact soil liner, basin underdrainage collection system, underdrain collection sump and embankment toe drain ▪ Capping of the WRDs to reduce ongoing water infiltration and seepage ▪ Cap WRD with suitable waste rock ▪ Continued use of drainage controls and bunds ▪ Construction of abandonment bund around the processing plant ▪ Maximise runoff pond capacity prior to wet season ▪ Design, storage and handling of hazardous materials to Australian Standards and regulations ▪ Specific adherence of the ANFO storage to *Dangerous Goods Act 1998* and the NT *Work Health and Safety (National Uniform Legislation) Act 2011*

	▪ Regular maintenance of storage facilities ▪ Bunding of the process plant ▪ Diesel in bunded storage tanks, waste oil in stored bunded tanks ▪ Chemical storage will be located a minimum 30 m from any drainage line or watercourse ▪ Design and construct landfill in accordance with relevant standard ▪ Implement leachate prevention and capture into landfill design ▪ Clearly mark limits of clearing **Mitigation and Management** ▪ Implement erosion and sediment controls in accordance with an ESCP ▪ Implementation of Biodiversity Management Plan ▪ Groundwater and surface water monitoring to check quality and any seepage ▪ Tailings performance monitoring (e.g. TSF water volume, collection efficiency of underground system) ▪ Implementation of AMDMP and WMP ▪ Development of Monitoring Plan / Operational Manual which includes weekly inspections of the TSF and process water dam, survey pins to monitor the embankment and piezometers to measure pore water pressure ▪ Development of Monitoring Plan / Operational Manual which includes weekly inspections of the process water dams ▪ Manage the site water balance to reduce any build-up of water ▪ Daily monitoring of waste rock handling and tailings disposal ▪ Tailings and Waste Rock will be managed in accordance with the Tailings Management Plan and Operational Manual (including inspections) ▪ Infrastructure design to withstand extreme events ▪ Improve site drainage controls ▪ Clearing and Topsoil Procedures Implementation during operation ▪ Corporate commitment to EMS implementation via policy ▪ Environmental Management System and various management plans (e.g. EMP, WMP, MMP) ▪ All personnel will be trained in the appropriate relevant management practices and protocols as is applicable to their position ▪ Develop Emergency Response Plan and include in induction ▪ Spill kits available around the site and procedures and training for the cleaning up of hazardous spills ▪ Implementation of hazardous materials management plan training for emergency response ▪ Cyanide management and storage will be aligned to the Commonwealth of Australia Leading Practice Handbook for Sustainable Mining - Cyanide Management (Australian Government 2008). ▪ Compliance with the WDL ▪ All water storage facilities geotechnically stable and engineered ANCOLD guidelines ▪ Regular surveys to measure the tailings and waste rock deposition and water depths ▪ Improve and maintain site drainage infrastructure ▪ Geochemical assessment and modelling of pit water ▪ Contingency to manage water chemistry changes ▪ Contaminant transport modelling further refined ▪ Manage disposal of wastes in accordance with the Project EMP (including bunded waste oil bins) **Rehabilitation** ▪ Progressive clearing and rehabilitation of disused areas ▪ Implementation of detailed mine closure plan ▪ Review options for WRD Rehabilitation ▪ Financial provisioning for closure implementation ▪ Recover topsoil from TSF, WRD and processing plant footprints

Erosion and sedimentation associated with mining activities and infrastructure altering soil quality and landforms	**Avoid** ▪ Only clearing the practical minimum footprint necessary for the portion of the Project to be implemented ▪ Clearly mark limits of clearing ▪ Make use of already disturbed areas where possible ▪ Adhere to buffer widths recommended by the Northern Territory Land Clearing Guidelines with regard to riparian vegetation in drainage lines ▪ Avoid land clearing during December to March portion of the wet season ▪ TSF to be planned, designed, constructed and operated in accordance with approaches details in the guideline Tailings Management: Leading Practice Sustainable Development Program for the Mining Industry (Australian Government 2016) ▪ Design TSF to contain a range of design storm and rainfall sequences events up to and greater than the required design criteria ▪ Development of Monitoring Plan / Operational Manual which includes weekly inspections of the TSF, survey pins to monitor the embankment and piezometers to measure pore water pressure ▪ Development of Monitoring Plan / Operational Manual which includes weekly inspections of the process water dams ▪ Continued use of drainage controls and bunds ▪ Construction of abandonment bunds around the processing plant **Mitigation and Management** ▪ Development of Monitoring Plan / Operational Manual which includes weekly inspections of the TSF, survey pins to monitor the embankment and piezometers to measure pore water pressure ▪ Development of Monitoring Plan / Operational Manual which includes weekly inspections of the process water dams ▪ Adherence to Ground Disturbance Procedures ▪ Implement erosion and sediment controls in accordance with an ESCP ▪ Implementation of Biodiversity Management Plan ▪ Implementation of AMDMP and WMP ▪ Development of Monitoring Plan / Operational Manual which includes weekly inspections of the TSF, survey pins to monitor the embankment and piezometers to measure pore water pressure ▪ Development of Monitoring Plan / Operational Manual which includes weekly inspections of the process water dams ▪ Daily monitoring of waste rock handling and tailings disposal ▪ Tailings and Waste Rock will be managed in accordance with the Tailings Management Plan and Operational Manual (including inspections) ▪ Infrastructure design to withstand extreme events ▪ Improve site drainage controls ▪ Clearing and Topsoil Procedures Implementation ▪ Corporate commitment to EMS implementation via policy ▪ Environmental Management System and various management plans (e.g. EMP, WMP, MMP) ▪ All personnel will be trained in the appropriate relevant management practices and protocols as is applicable to their position ▪ Regular maintenance and inspections of plant **Rehabilitation** ▪ Progressive clearing and rehabilitation of disused areas ▪ Implementation of detailed Mine Closure Plan ▪ Review options for WRD Rehabilitation ▪ Financial provisioning for closure implementation ▪ Recover topsoil from TSF, WRD and processing plant footprints

7.1.3.1 Loss of Biological Function in Cleared Areas

Loss of biological function of topsoils that prevents revegetation success during rehabilitation has been identified as one of the major risks to the environmental values of Terrestrial Environmental Quality. Avoidance of these potential impacts includes to minimise the areas of disturbance from clearing including the implementation of buffer zones along drainage lines where possible. Native vegetation clearing will only occur after obtaining a permit to clear immediately prior to construction works and during the dry season to minimise the risk of erosion and sedimentation. Further measures to avoid erosion and sedimentation are outlined in the Project ESCP (Appendix L).

To restore function after disturbance, topsoil is to be stripped from land clearing areas and stockpiled to provide suitable soil and seedbanks for rehabilitation. Disturbed areas will be rehabilitated progressively during operations. Active re-vegetation of rehabilitated landforms will be maintained throughout the closure process to minimise future erosion. As outlined in the Draft Mine Closure Plan, the main issues surrounding the management and restoration of the relevant environmental quality are rehabilitation and AMD during the mining closure process.

7.1.3.2 Contamination

To minimise the potential for AMD soil contamination, WRD and TSF landforms will be designed by appropriately qualified engineers in accordance with accepted industry guidelines and standards. The landform designs and closure strategies will be informed by detailed waste rock and ore geotechnical and geochemical characterisation studies. Further screening of problematic materials volumes and the availability of suitable material to encapsulate the waste will occur during mine planning.

To prevent AMD from PAF rock, fresh waste material will be backfilled into Zamu pit (Quest 29), the two smaller pits at Rustlers Roost (Annie's Oakley and Annie's Dam pits), minimising the volume of material being exposed for oxidation. A total of 5.36 Mt, from the 50.9 Mt of waste rock extracted from the Rustlers Roost main pit, is also proposed to be backfilled into the main pit. Backfilling of pits with PAF rock and encapsulating the material is a leading mining practice strategy that results in less PAF material being exposed to oxidation and remaining on the surface. Due to the quantity of waste rock that will be produced, WRD landforms will be designed to contain the remainder of the waste material. This waste will be managed through the development of an AMD Management Plan. Frequent monitoring of surface and groundwater quality, sediment and biotic components in accordance with the WMP will identify potential contamination pathways.

Hazardous material contamination is avoided through minimising the use and disposal of chemicals, through adequate storage and transport and the disposal off-site at licensed facilities. Storage facilities and handling of processing chemicals and hydrocarbons will be designed appropriately in accordance with the Australian Standard 1940-2004. The storage and handling cyanide will be in accordance with the Cyanide Management Practice Leading Practice guidelines (Australian Government 2008). Any incidents and spills will be managed under a relevant Incident and Spill Management Plan.

7.1.3.3 Ground Stability, Erosion and Sedimentation

To avoid significant erosion and sedimentation only earthworks that are absolute necessary for the relevant Project phase will be conducted. Clearing and earthworks over the wet season will be avoided where possible to prevent soil mobilisation and erosion prior to implementation of control measures. In general, all earthworks will be managed to minimise disturbance to drainage channels and erosion. Various strategies will be used on site, depending on the exact location, the proximity to watercourses or other sensitive receiving environments and the slope of the land. Prior to any disturbance to land, a Permit to Clear will be obtained. Strategies to prevent erosion from clearing are outlined in detail in the ESCP for Rustlers Roost and Quest 29 (Appendix L).

The potential for erosion from infrastructure within the mine site will be minimised by adopting appropriate design criteria for expansion components (i.e., TSF, processing plant, WRD expansions, pit expansions, and haul route). This will include erosion controls like re-vegetation, height limit for topsoil piles, slope limits for stockpiles, WRD and TSF dam walls, and the retention of buffer zones in clearing areas. Impacts from sedimentation will be controlled through buffer zones in nearby drainage lines, sediment traps, diversion banks, dams, barriers and basins in the drainage line of WRD and TSF dam wall, as well as infrastructure (e.g. processing plant, access and haul roads). Details of the construction operation erosion control measures and maintenance of existing controls has been provided in the ESCP for the Project (Appendix L), developed in accordance with the Best Practice Erosion and Sediment Control Guidelines (IECA 2008).

7.1.3.4 Rehabilitation and Mining Closure

An overview of the closure and rehabilitation approach for the Project has been described previously in Section 4.14. The Draft Mine Closure Plan (included in Appendix J) outlines the complete rehabilitation framework of the Rustlers Roost and Quest 29 mine site to a safe and stable post mining landform. The final land use and closure objectives will be determined in consultation with the pastoral lease holders and other stakeholders.

The processing facility and associated mining infrastructure will be removed from site and the areas rehabilitated. The final WRD and TSF landforms will be suitably shaped, capped, and rehabilitated and remain within the Project Area footprint. Abandonment bunds will be constructed around the remaining open pits, which will be left to form pit lakes. The legacy Heap Leach Facilities will be removed to backfill pits or capped and revegetated and the backfilled pits will be covered with topsoil, shaped and revegetated. Haul roads, ROM, go-line and all other disturbed areas will be ripped and revegetated. A post-closure monitoring programme will be implemented when closure commences. This will be incorporated as part of the Mine Closure Plan. All rehabilitation activities will be informed by relevant industry standards and policy and guidance provided by Commonwealth and Northern Territory Government.

7.1.4 Monitoring and Reporting

Groundwater, surface water and soils will be monitored for potential contamination of surrounding land and soils, as outlined in the WMP (Appendix I), ESCP (Appendix L) and the AMDMP (Appendix T). Active discharge from site will be managed via a WDL. Water quality monitoring and reporting will be conducted in accordance with the Australia and New Zealand Government (ANZG) Guidelines for Fresh and Marine Water Quality (2018) and default Site-Specific Trigger Values (SSTVs).

To confirm geotechnical stability of pit walls, TSF and WRD walls, weekly inspections will be conducted to check sufficient freeboard and structural integrity. Daily inspections will be conducted for runoff and drainage problem areas. Weekly inspections will be conducted of hazardous storage areas, tanks and containers and for leaks or damages, of waste areas, landfill and general tidiness of site. All monitoring and reporting activities will be informed by relevant industry standards and policy and guidance provided by the Commonwealth and Northern Territory Government legislative and regulatory framework.

7.1.5 Residual Impact

All potential residual impacts to environmental values of terrestrial environmental quality were assessed as being moderate or lower, following application of controls. Some of the sources of potential impacts exhibiting moderate residual risk include those associated with overtopping, embankment failure or seepage from the TSF leading to uncontrolled release of tailings, or uncontrolled release of process water. These are acknowledged as risks to be closely managed through best practice design, management and monitoring.

The clearing of native vegetation is unavoidable, as the Project will require clearing of native vegetation to gain access to ore reserves and for supporting infrastructure. The clearing of native vegetation has been conservatively classified as extreme inherent (unmitigated) risk for terrestrial environmental quality during the risk assessment process due to the potential erosion, loss of topsoil and sedimentation. Mitigation measures like progressive clearing with a limit to the absolute necessary areas, the use of already disturbed areas, avoidance of clearing during the wet season, retaining of buffer zones regarding riparian vegetation and drainage lines in accordance with Northern Territory Land Clearance Guidelines, implementation of erosion and sedimentation controls in accordance with the ESCP and progressive rehabilitation has lowered the residual risk of erosion and sedimentation to a moderate level.

The risk assessment process classified the inherent risk of unfinished/unsuccessful rehabilitation due to inadequate funds or natural disaster (e.g. cyclone) as extreme. The risks were identified and addressed with relevant mitigation measures such as early planning, pre-feasibility assessment and financial provision for closure works and progressive rehabilitation during operations. The Draft MCP addresses these issues in accordance with relevant legislation (*Mining Management Act 2001*). The application of the relevant mitigation measures resulted in a moderate residual risk classification.

The Project acknowledges that despite the efforts to reduce the likelihood of uncontrolled discharges (i.e. from overtopping, embankment failure or seepage from the TSF or process water storage) the consequence to the environment will still remain at a moderate level as per the consequence classifications for terrestrial environmental quality in the risk assessment framework. These residual risks remained moderate after the application of control measures. This rating is due to the potential consequences for receiving environments outside the Project area where contaminated sediments could be deposited outside the Project area and potentially within ecologically important areas of the Adelaide River and Mary River catchment, while acknowledging a very low likelihood of such an event.

The inability to re-establish local vegetation that may be associated with land clearing and resulting erosion of soils and landforms has been classified as an inherently high risk during the risk assessment process. Stockpiling of stripped topsoils for later rehabilitation will support rehabilitation, hence erosion prevention due to existing seed banks in the topsoil. This methodology has been applied successfully at sites within the NT. The residual risk is moderate due to variable factors like seed bank quality, weed pressure and extreme weather events that may affect rehabilitated areas.

The significance of the residual risk for terrestrial environmental quality from the Project have been assessed, assuming the successful implementation of avoidance, mitigation and management measures as outlined in Section 7.1.3. The residual risk for each source of impact is shown in Table 7-11.

Table 7-11 Terrestrial Environmental Quality Residual Impact Assessment Summary

Risk No.	Source of Impact	Project Phase(s)	Inherent Risk	Summary of Controls	Residual Risk
TEQ-1	Vegetation clearing for the Project	Construction, Operation	Extreme	> Adherence to Ground Disturbance Procedures > Progressive clearing and rehabilitation > Implement erosion and sediment controls in accordance with an ESCP >Only clearing the practical minimum footprint necessary for the portion of the Project to be implemented > Implementation of Biodiversity Management Plan > Clearly mark limits of clearing > Make use of already disturbed areas where possible. > Adhere to buffer widths recommended by the Northern Territory Land Clearing Guidelines with regard to riparian vegetation in drainage lines > Avoid land clearing during the December to March portion of the wet season.	Moderate
TEQ-2	Overtopping, embankment failure or seepage from the new TSF at Rustlers Roost leading to uncontrolled release of tailings material to surrounding environment.	Construction, Operation, Decommissioning, Closure	High	> TSF to be planned, designed, constructed, and operated in accordance with approaches details in the guideline Tailings Management: Leading Practice Sustainable Development Program for the Mining Industry (Australian Government 2016) > Design TSF to contain a range of design storm and rainfall sequences events up to and greater than the required design criteria. > An operational emergency spillway to be constructed as part of each embankment raise > Development of Monitoring Plan / Operational Manual which includes weekly inspections of the TSF, survey pins to monitor the embankment and piezometers to measure pore water pressure > Tailings performance monitoring (e.g. TSF water volume, collection efficiency of underground system) > Install seepage control and underground drainage including a cut-off trench, compact soil liner, basin underdrainage collection system, underdrain collection sump and embankment tow drain > Groundwater and surface water monitoring to check quality and any seepage > Implementation of AMDMP and WMP > Manage the site water balance to reduce any build-up of water	Moderate

Risk No.	Source of Impact	Project Phase(s)	Inherent Risk	Summary of Controls	Residual Risk
TEQ-3	Overtopping, embankment failure or seepage from the process water storage at Rustlers Roost leading to uncontrolled release of process water to surrounding environment.	Operation, Decommissioning, Closure	High	> Development of Monitoring Plan / Operational Manual which includes weekly inspections of the process water dams. > Groundwater and surface water monitoring > Implementation of AMDMP and WMP > Manage the site water balance to reduce any build-up of water. > Storage and management of cyanide in accordance with the Commonwealth of Australia Leading Practice Handbook for Sustainable Mining - Cyanide Management (2008). > Water quality monitoring, reporting in accordance with ANZG (2018) guidelines and site specific trigger values, *Water Act 1992* and *Waste Management and Pollution Control Act 1998*.	Moderate
TEQ-4	Embankment failure of Annie's Dam water storage and uncontrolled water and sediment release.	Construction, Operation	Moderate	> Structural stability and integrity inspections of the existing dam wall and diversion in accordance with standard engineering practices. > WMP > Weekly inspections to check sufficient freeboard and structural integrity	Low
TEQ-5	Poor quality runoff or seepage from the historic WRDs and heap leaches.	Construction, Operation, Decommissioning, Closure	Moderate	> Continued use of drainage controls and bunds > Maximise runoff pond capacity prior to wet season > Ongoing monitoring of existing groundwater bores > Investigation and consideration of long-term closure options > Cap with suitable waste rock > Calculations, identification, and provisioning of suitable cap material > Implementation of AMD management plan > Daily inspections for runoff and drainage problem areas	Low
TEQ-6	Geotechnical instability and failure of pit wall, TSF or WRD walls.	Construction, Operation, Decommissioning, Closure	High	> Detailed design and quality assurance/control of TSF, WRD and pit wall designs. > Geotechnical studies and assessment to ensure structural stability > Engineering design to ANCOLD standard > WMP > Weekly inspections to check sufficient freeboard and structural integrity	Low

Risk No.	Source of Impact	Project Phase(s)	Inherent Risk	Summary of Controls	Residual Risk
TEQ-7	Indiscriminate use of existing waste rock for construction. Storage of waste rock outside of pit footprint for too long.	Construction, Operation, Decommissioning, Closure,	Moderate	> Tracking of the waste rock and dumping locations > WRD plan > ESCP to prevent mobilisation > Implementation of AMDMP and WMP > Maximisation of placement within pits > Testing of waste rock for AMD, heavy metals and NORMS prior to use as on or offsite construction material	Low
TEQ-8	Failure of process tanks/pipes/pumps.	Operation	High	> Water storage tanks stored in containment bunding > Pipelines, pumps and tanks selected for appropriate water capacity > Drainage to processing plant area sump > Pumps operated in accordance to supplier specification and operating manuals > Installation of automated operating alarms to alert of pipe pressure drops > Weekly inspections for structural integrity, leaks and subsequent maintenance > Bunding of the area around the process plan and piping > Completion of maintenance as per manufacture scheduled recommendations > Emergency response procedures > Training and induction including emergency response	Low
TEQ-9	Erosion of site infrastructure leading to sedimentation	Operation, Decommissioning, Closure	High	> Implementation of ESCP > Ongoing and regular (weekly) inspections of Project areas and after rainfall events > Avoid land clearing during wet season > Minimise concentrated flow of surface water and ponding (drain lines, sediment bunds, liners etc.) > Revegetation of exposed areas where not proposed to be utilised > Stable design of landforms > Construction of Project infrastructure with suitable materials	Moderate

Risk No.	Source of Impact	Project Phase(s)	Inherent Risk	Summary of Controls	Residual Risk
TEQ-10	Release of hazardous chemicals or materials during storage and handling onsite.	Construction, Operation, Decommissioning	High	> Design, storage, and handling of hazardous materials to Australian Standards and regulations. > Specific adherence of the ANFO storage to *Dangerous Goods Act 1998* and the NT *Work Health and Safety (National Uniform Legislation) Act 2011.* > Regular maintenance of storage facilities. > Bunding of the process plant. > Ensure containment bunding is adequate and SDS available. > Diesel in bunded storage tanks, waste oil in stored bunded tanks. > Weekly inspections of storage areas, tanks, containers. > Develop Emergency Response Plan and include in inductions. > Weekly inspections of storage areas for leaks or damages. > Spill kits available around the site and procedures and training for the cleaning up of hazardous spills. > Implementation of hazardous materials management plan training for emergency response. > Cyanide management and storage will be aligned to the Commonwealth of Australia Leading Practice Handbook for Sustainable Mining - Cyanide Management (Australian Government 2008). > Chemical storage will be located a minimum 30m from any drainage line or watercourse.	Moderate
TEQ-11	Release of hazardous chemicals or materials during transportation to site.	Construction, Operation	High	> Standard pre-requirements for contractors (must meet standard requirements and licencing). > Appropriate site access for large vehicles. > Ensure transportation contractors undertake standard pre-departure checks. > All external operators to complete induction that includes transportation safety considerations. > Emergency management plan, spill response for transport incidents on site.	Moderate

Risk No.	Source of Impact	Project Phase(s)	Inherent Risk	Summary of Controls	Residual Risk
TEQ-12	Production of domestic waste and storage of the waste onsite	Construction, Operation, Decommissioning.	Moderate	> Secure dustbin lids. > Establish dedicated hardstand at accommodation camp for waste receptacles. > Weekly inspections of, waste area, landfill, and general tidiness of site. > Burial of waste in dedicated landfill. > Design and construct landfill in accordance with relevant standards. > Implement leachate prevention and capture into landfill design. > Groundwater monitoring. > Segregation of wastes and recycling of wastes where possible. > Adhering to disposal licence conditions.	Low
TEQ-13	Unfinished/unsuccessful rehabilitation of Project due to inadequate funds or natural disaster (e.g. cyclone).	Construction, Operation, Decommissioning and Closure	Extreme	> Progressive rehabilitation of disused areas. > Implementation of detailed mine closure plan. > Early planning and financial provision for closure works. > Infrastructure design to withstand extreme events. > Ongoing management of levels in water infrastructure. > Improve site drainage controls. > Topsoil stockpiling. > Progressively push down the sides of the waste dump walls during mining so that most earthworks are completed during the operational period.	Moderate
TEQ-14	Inability to establish native vegetation by local provenance species with resultant cover comparable to nearby areas	Operation, Decommissioning Closure	High	> Financial provisioning for closure implementation. > Rehabilitation trials to determine effective methods Rehabilitation monitoring. > Final closure design to account for rehabilitation potential. > Planning and allocation of appropriate rehabilitation media (topsoil and organic matter). > Establishment of a fire regime that promotes native vegetation. > Implement active weed control. > Topsoil stockpiling.	Moderate
TEQ-15	Lack of rehabilitation materials leads to inadequate tailings closure and poor quality site rehabilitation.	Decommissioning and Closure	High	> Financial provisioning for closure implementation. > Calculation of material requirements and identification of extraction areas > Recover topsoil from TSF, WRD and processing plant footprints. > Progressively rehabilitating the mine. > Clearing and Topsoil Procedures Implementation of Mine Closure	Moderate

Risk No.	Source of Impact	Project Phase(s)	Inherent Risk	Summary of Controls	Residual Risk
TEQ-16	Inappropriate management of the decommissioned site, post closure landform.	Closure	Moderate	> Implement fencing and access restriction to prevent vehicle and livestock accessing rehabilitation areas. > Ongoing monitoring of rehabilitation. > Progressive rehabilitation during mining to enable more established areas upon closure	Low
TEQ-17	Ineffective operational implementation of site environmental management system, plans and procedures.	Construction, Operation, Decommissioning Closure	High	> Corporate commitment to EMS implementation via policy > Environmental Management System and various management plans (e.g. EMP, WMP, MMP). > All events/incidents to be reported and managed through to resolution via event/incident reporting procedures. > All personnel will be inducted into the area and informed of the hazards and relevant management protocols of the areas. > All personnel will be trained in the appropriate management practices as is relevant to their position.	Moderate
TEQ-18	Use of Project machinery, equipment, vehicles and activities causing fire through sparks or heat ignition source.	Construction, Operation, Decommissioning Closure	High	> Liaise with Bushfires NT regarding regional (and site) fire break > Establish hot work procedures > Regular inspections of generators and other sources of heat/power. > Fire extinguishers available around site and on all vehicles and machinery. > Training and inductions include Emergency Response Plan. > Establish and implement appropriate control fire regime for area in the MLs.	Moderate
TEQ-19	Dust generation from Project activities such as vehicular movements and earthworks.	Construction, Operation, Decommissioning Closure	Moderate	> Implementation of Dust Management Plan. > Progressive clearing and progressive rehabilitation. > Avoid clearing on windy days. > Visual monitoring of emissions. > Speed limits for vehicle movements.	Low

Risk No.	Source of Impact	Project Phase(s)	Inherent Risk	Summary of Controls	Residual Risk
TEQ-20	Inappropriate liquid and solid waste disposal.	Construction, Operation, Decommissioning Closure	High	> Manage disposal of wastes in accordance with the Project EMP (including bunded waste oil bins). > Hazardous materials stored in accordance with Australian standards. > Spill kits available around site and spill clean-up procedures implemented. > Employees and contractors trained in clean up procedures. > Weekly inspections of, waste area, landfill and general tidiness of site. > Burial of waste in dedicated landfill. > Design and construct landfill in accordance with relevant standards > Implement leachate prevention and capture into landfill design > Groundwater monitoring	Low

7.1.6 Predicted Outcome and Conclusions

The proposed mining activity will result in loss of vegetation and construction of mining infrastructure like TSF and WRD and expose soils and landform to erosion and sedimentation. Another potential risk is the contamination of soils with mining residuals (AMD) and chemicals. Failure to rehabilitate will result in ongoing landform instability with erosion of material and soils beyond mining closure. While each of these outcomes are significant, the Terrestrial Environmental Quality risk assessment has demonstrated that impacts on soils and landforms are manageable through avoidance, management and mitigation measures identified in Section 7.1.3. Furthermore, relevant management plans including the MMP, ESCP, WMP and MCP will outline specific measures, monitoring and reporting requirements to achieve the environmental outcomes.

The environmental objective identified in the ToR (NT EPA 2021) for terrestrial environmental quality is to protect soil and landform function to support other environmental values including biodiversity, ecological integrity and ecological functioning. With the application of appropriate mitigation measures, it is concluded that the Project risks are manageable such that environmental values are supported and maintained.

The Project provides an opportunity to enable further mining with minimal environmental risk; while creating the opportunity to mitigate the historic disturbance to the area from previous operations, including WRDs, water quality and land rehabilitation by application of contemporary industry practice in environmental management.

Considering the assessment of residual impacts, and the application of mitigation and monitoring committed to by PGO, it is concluded that impacts on Terrestrial Environmental Quality are manageable, such that the ToR objective for this factor is able to be met.

7.1.7 Assumptions

The key assumptions made in assessing potential impacts on terrestrial environmental quality are:

- Erosion and sedimentation risk will be effectively addressed through the ESCP;
- The WRD and TSF will be designed, constructed and operated in accordance with leading practice. The management strategy for PAF material is based on there being sufficient acid neutralising materials available to encapsulate the wastes. It has been assumed that the landform designs will provide for effective long-term prevention and/or containment of AMD;
- Erosion risks associated with early or unexpected closure, will be addressed to the satisfaction of DITT through the MMP process;
- A final Mine Closure Plan, building on the draft MCP presented in Appendix J, will be implemented to make the site safe, non-polluting and mitigate long-term impacts; and
- Storage and handling of processing chemicals and hydrocarbons will be in accordance with accepted standards and guidelines.