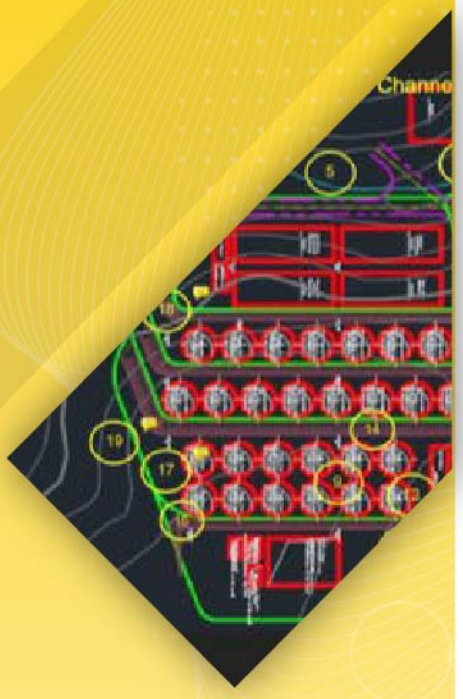
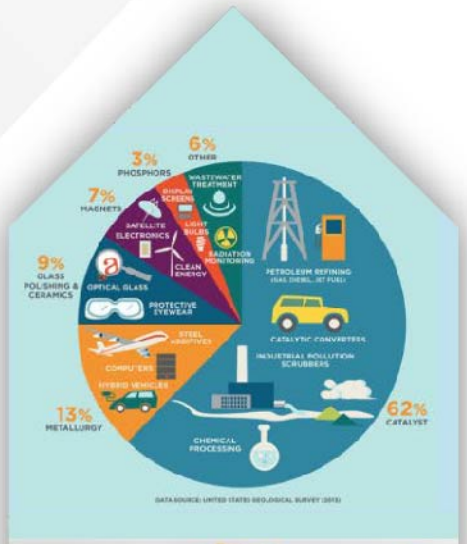
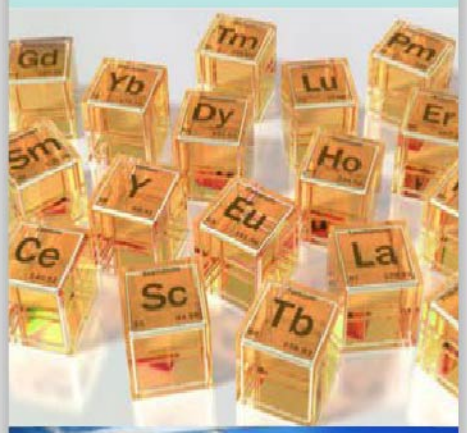
KEMENTERIAN TENAGA DAN SUMBER ASLI

JABATAN MINERAL DAN GEOSAINS MALAYSIA







Standard Operating Procedure (SOP) of
NON-RADIOACTIVE RARE EARTH ELEMENTS (NR-REE)
MINING IN PERAK

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KEMENTERIAN TENAGA DAN SUMBER ASLI

2022

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GLOSSARY

ACIDIC INTRUSIVE ROCKS	Rocks that is either siliceous, having a high content of silica (SiO_2), or rock with a low pH
ACTINOID SERIES	Also called actinide series encompasses the 15 metallic chemical elements with atomic numbers from 89 to 103, actinium through lawrencium
AGGREGATE	A material or structure formed from a mass of fragments or particles loosely compacted together.
AGING CRYSTALLIZATION	Crystallization is the (natural or artificial) process by which a solid forms, where the atoms or molecules are highly organized into a structure known as a crystal.
ALLOY	A mixture of metals or a metal and another element. Alloys may be a solid solution of metal elements or a mixture of metallic phases
ALLUVIAL TIN DEPOSITS	Tin mineral concentrated by the movement of water in a stream or river.
ALUMINOSILICATE MINERALS	Aluminosilicate minerals are minerals composed of aluminium, silicon, and oxygen, plus counteractions.
AMANG	Local term used for the millings by-product from treatment plants of tin mines.
AMORPHOUS	Non-crystalline solid is a solid that lacks the long-range order that is characteristic of a crystal.
BASKET PRICE	The value (USD) of one unit mass (1 kg) of separated REO, in which those REOs are in the same proportion as the deposit.
BITUMINOUS	Black coal is a relatively soft coal containing a tarlike substance called bitumen or asphalt.
BRECCIATION	The formation of breccia, or masses of rock composed of fragments of older rock fused together
BUCKET WHEEL DREDGES	The bucket-wheel dredge is identical to the cutter suction dredge except that a wheel excavator is used in place of the rotary cutter.
BUFFER ZONE	Buffer zones are areas created to enhance the protection of a specific conservation area, often peripheral to it.
BULK SAMPLING	The process of taking very large *samples*, is part of the general procedure for the exploration and evaluation of a mineral deposit.

CAPITAL EXPENDITURE	Funds used by a company to acquire or upgrade physical assets such as property, industrial building or equipment
DEEP SEATED TIN DEPOSITS	An ore deposit formed at an estimated depth of 12,000 ft (3.66 km) or more, at temperatures ranging from 300° to 575°
DIDYMIUM	A mixture of the elements Pr and Nd
EARTH DRAIN	A compacted earth or gravel ridge, excavated channel or a combination of ridge and channel designed to direct runoff away from or around disturbed areas.
EROSION	The process of eroding or being eroded by wind, water, or other natural agents.
EXPLORATION	The process by which geological information is collected and analysed to identify mineral deposits as well as determining the economic feasibility of their extraction.
FEASIBILITY STUDY	An evaluation of a proposed mining project to determine whether the mineral resource can be mined economically.
FOSSICKING	The collection of mineral samples or specimens, other than gold or diamonds, for the purpose of a mineral collection, lapidary work or hobby interest.
GANGUE	The ore is always mixed with unwanted or valueless rocks and minerals that are collectively known as *gangue*.
GEOMORPHOLOGY	The study of the physical features of the surface of the earth and their relation to its geological structures.
GRADE	Grade is measurement of the metal content of ore. The grade is usually measured in %. Grams per ton (ppm) or troy ounces per tonne. The REO is normally measured in either ppm or %.
GROSS DOMESTIC PRODUCT	The monetary value of all goods and services produced within a nation's geographic borders over a specified period of time.
HEAVY RARE EARTH ELEMENTS	Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu and Y metals (as applied by EURARE report)
HEAVY RARE EARTH OXIDES	Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu and Y oxides (as applied by EURARE report)
HYDRAULIC CONDUCTIVITY	The ratio of velocity to hydraulic gradient indicating permeability of porous media.
HYDRAULIC SLUICING	One of processes in hydraulic mining. The process of moving the slurry after by using a large water cannon called a giant or monitor.
IN-SITU LEACHING	In-situ leach mining involves pumping of a lixiviant into the ore body via a borehole, which circulates through the porous rock dissolving the ore and is extracted via a second borehole.

ISOPACHYTE PLANS	Displays lines of equal thickness in a layer where the thicknesses are measured perpendicular to the layer boundaries.
LANTHANIDE GROUP	The lanthanide or lanthanoid series of chemical elements comprises the 15 metallic chemical elements with atomic numbers 57–71, from lanthanum through luthetium.
LEACHING	Leaching involves the use of aqueous solutions to extract metal from metal bearing materials which is brought into contact with a material containing a valuable metal.
LIGHT RARE EARTH ELEMENTS	La, Ce, Pr, Nd, Sm (as applied in this EURARE report).
LIGHT RARE EARTH OXIDEs	La, Ce, Pr, Nd, Sm (as applied in this EURARE report).
LITHOLOGY	The physical characteristics of a rock or stratigraphic unit.
MAGNETIC SOUNDING	Geophysical survey technique that use of electromagnetic induction methods to determine the electrical conductivity within the Earth, working from observations of natural geomagnetic variations.
MEDIUM RARE EARTH ELEMENTS	Sm, Eu, Gd, Tb, Dy metals (according to classification by Kirk-Othmer, 2005).
MEDIUM RARE EARTH OXIDES	Sm, Eu, Gd, Tb, Dy oxides (according to classification by Kirk-Othmer, 2005)
MILLION TON	1 million tonnne (metric).
MINERAL PROCESSING	Mineral processing, art of treating ores and mineral products in order to separate the valuable minerals from the waste rock, or gangue. It is the first process that most ores undergo after mining in order to provide a more concentrated material for the procedures of extractive metallurgy.
MISCHMETAL	Describe “mixed metal”, namely an alloy of rare earth elements.
NET PRESENT VALUE	Difference between the present values of cash inflows and outflows.
OPEN PIT METHOD	An excavation or cut made at the surface of the ground for the purpose of extracting ore and which is open to the surface for the duration of the mine’s life.
ORE BENEFICIATION	In the mining industry or extractive metallurgy, beneficiation is any process that improves the economic value of the ore by removing the gangue minerals, which results in a higher grade product (concentrate) and a waste (tailings).
PARTS PER MILLION	Measure of some ore grade: gram metal per tonne of ore.
PHYLOSILICATE	A mineral of a class of polymeric silicates in which the silicon-oxygen tetrahedral groups are linked by sharing three of every four oxygen atoms so as to form sheets of indefinite extent, in which the ratio of silicon to oxygen is

	2:5. Some silicon atoms may be replaced by aluminum (as in mica, chlorite, kaolinite).
PIEZOMETER	A device used to measure liquid pressure in a system by measuring the height to which a column of the liquid rises against gravity, or a device which measures the pressure of groundwater at a specific point.
POROSITY	The ratio expressed as a percentage, of the volume of the pores or interstices of a substance, as a rock or rock stratum, to the total volume of the mass.
PREGNANT SOLUTION	A solution containing dissolved extractable mineral that was leached from the ore.
PROSPECTING	Prospecting is the first stage of the geological analysis (second – exploration) of a territory
RADIONUCLIDES	A radionuclide is an atom that has excess nuclear energy, making it unstable.
RARE EARTH ELEMENT	15 lanthanides plus Sc and Y metals.
RARE EARTH OXIDE	15 lanthanides plus Sc and Y oxides.
RARE EARTH CARBONATE	A final product from precipitation process of rare earth sulphate solution using ammonium carbonate or oxalic acid.
REE-BEARING MINERALS	One of a set of seventeen chemical elements in the periodic table, specifically the fifteen lanthanides, as well as scandium and yttrium.
REGOLITH	Layer of unconsolidated solid material covering the bedrock of a planet.
REST OF THE WORLD	All countries of this world, excluding China. A term that can be traced back to the highly politicized debate on REE critically.
RIPARIAN	Relating to or situated on the banks of a river.
RUN OF MINE	Relating to ore or coal that is crude, ungraded.
SEDIMENT BASIN	A depression in the crust of the Earth formed by plate tectonic activity in which sediments accumulate.
SEDIMENTATION	The action or process of forming or depositing sediment.
SEISMIC REFRACTION	Refraction of elastic waves on passing between formations of rock having different seismic velocities.
SILT FENCES	A temporary sediment control device used on construction sites to protect water quality in nearby streams, rivers, lakes and seas from sediment in stormwater runoff.
SILT TRAP	A designated area where water that is contaminated with suspended sediment as a result of construction activity or water runoff is contained.
SLAG HEAD	A hill or area of refuse from a mine or industrial site.
STOCKPILE	A large accumulated stock of ores, especially one held in reserve for use at a time of shortage or other emergency.

STRATIGRAPHY	A branch of geology concerned with the study of rock layers (strata) and layering (stratification). It is primarily used in the study of sedimentary and layered volcanic rocks.
SUPERGENE ENRICHED COPPER DEPOSIT	Occurs at the base of the oxidized portion of an ore deposit. This is particularly noted in copper ore deposits where the copper sulphide minerals.
SUPERNATANT	The usually clear liquid overlying material deposited by settling, precipitation, or centrifugation.
TAILING	The materials left over after the process of separating the valuable fraction from the uneconomic fraction (gangue) of an ore.
TOTAL RARE EARTH ELEMENTS (TREE)	Collective term for all REEs contained in a product, resource, reserve or basket.
TOTAL RARE EARTH OXIDE (TREO)	Collective term for all REOs contained in a product, resource, reserve or basket.
UNDERSCREEN WATER	Water that has been recycle from hydrometallurgical plant to be use for In-situ leaching mining.
UN-MINERALISED CARBONATITE	A type of intrusive or extrusive igneous rock defined by mineralogical composition consisting of greater than 50% carbonate minerals.
WEATHERED CRUST ELUTION DEPOSITED	Deposits contain a large amount of medium and heavy rare earth elements, which are the main source of medium and heavy rare earth in the world. This is adsorbed on the surface of clay minerals in the form of hydrated or carboxyl hydrated ions.

ABBREVIATIONS

3-D	Three Dimension
AELB	Atomic Energy Licensing Board
AIs	Appointed Individuals
AP	Approved Permit – Import/Export
ARE	Asian Rare Earth (Company)
ASTM	American Society for Testing and Materials
BAT	Best Available Technologies
BMG	Bahagian Mineral dan Geosains
BMPs	Best Management Practices
BoD	Board of Director
BOD	Biochemical of Oxygen Demand
CAGR	Compound Annual Growth Rate
Capex	Capital Expenditures
CAR	Clean Air Regulation
CePSWaM	Certified Environmental Professional in Scheduled Waste Management
CF	Certificate of Fitness
CM	Compliance Monitoring
COAs	Condition of Approvals
COD	Chemical Oxygen Demand
CSR	Corporate Social Responsibility
dBA	A-weighted decibels
DCF	Discounted Cash Flow
DG	Director General
DLM	Director of Land & Mines
DOE	Department of Environment
DOSH	Department of Occupational Safety and Health
eBMGPermit	Online System – electronic - Bahagian Mineral dan Geosains Permit
EIA	Environment Impact Assessment
EIATRC	EIA Technical Review Committee
EKMC	Enviro Knowledge Management Centre
EL	Exploration Licence
EM	Economic Mineral
EMP	Environmental Management Plan
EO	Environmental Officer

EQA 1974	Environmental Quality Act 1974
ERP	Emergency Respond Plan
ESA	Environmental Sensitive Area
ESAs	Environmental Site Assessments
ESC	Erosion and Sediment Control
ESCP	Erosion and Sediment Control Plan
ESI	Environmental Scoping Information
EXCO	Executive Council
FIBC	Flexible Intermediate Bulk Containers
FMA	Factories and Machinery Act
FOB	Freight Value on Board
GDP	Gross Domestic Products
GIS	Geographic Information System
GPS	Global Positioning System
GWP	GWP Consultants LLP
H/EVs	Hybrid and Electric Vehicles
HDPC	High Density Polyethylene
HIA	Health Impact Assessment
HIRARC	Hazard Identification, Risk Assessment and Risk Control
HREE	Heavy Rare Earth Elements
HREO	Heavy Rare Earth Oxide
IER	Industrial Effluent Regulation
IETS	Industrial Effluent Treatment Systems
IM	Impact Monitoring
IRR/ORR	Internal Rate of Return/Overall Rate of Return
ISL	In-Situ Leaching
ITA	International Tin Agreement
ITRI	International Tin Research Institute
JAS	Jabatan Alam Sekitar
JKJ	Jabatan Kilang dan Jentera
JKKP	Jabatan Keselamatan dan Kesihatan Pekerjaan
JMG	Jabatan Mineral dan Geosains
JMG.GP.16	Jabatan Mineral dan Geosains Garis Panduan 16
JORC	Joint Ore Reserves Committee
JPS	Jabatan Pengairan dan Saliran
JPSM	Jabatan Perhutanan Semenanjung Malaysia
JSMN	Jawatankuasa Sumber Mineral Negeri
KeTSA	Kementerian Tenaga dan Sumber Asli
KPPT	Ketua Penolong Pegawai Tanah
KPT	Ketua Pembantu Tadbir
KSU	Ketua Setiausaha

LAMP	Lynas Advance Material Plant
LDP2M2	Land Disturbing – Pollution Prevention Mitigation Measures
LREE	Light Rare Earth Elements
LREO	Light Rare Earth Oxide
M&A	Memorandum & Article of Association
MAREC	Malaysian Rare Earth Corporation
MDA	Mineral Development Act
ML	Mining Lease
MMK	Majlis Mesyuarat Kerajaan
MODFLOW	Modular Three-Dimensional Finite-Difference Groundwater Flow Model
MREE	Medium Rare Earth Elements
MRI	Magnetic Resonance Imaging
MSMA	Manual Saliran Mesra Alam
MSRs	Medium Source Rare - Earth Lamps
MT	Metric Tonne
MUSLE	Modified Universal Soil Loss Equation
MyKKP	My Keselamatan dan Kesihatan Pekerjaan
NGO	Non-Governmental Organization
NI43-101	National Instrument 43-101 (Canadian Code)
NMP	National Mineral Policy
NORM	Naturally Occurring Radioactive Minerals
NPV	Net Present Value
NRC	National Research Council
NR-REE	Non-Radioactive Rare Earth Elements
OMS	Operational Mining Scheme
Opex	Operating Expenses
PBN	Pihak Berkuasa Negeri
PBT	Pihak Berkuasa Tempatan
PC	Personal Computer
pH	Potential of Hydrogen
PL	Prospecting Licence
PlanMalaysia	Jabatan Perancangan Bandar dan Desa Malaysia
PM	Performance Monitoring
PML	Proprietary Mining Licence
PO	Purchase Order
PPE	Personal Protective Equipment
PPT	Penolong Pegawai Tanah
PTG	Pengarah Tanah dan Galian
PT	Pembantu Tadbir
PTG	Pejabat Tanah Galian
PVs	Present Values

QA	Quality Assurance
QC	Quality Control
RIA	Radioactive Impact Assessment
RE	Rare Earth
REE	Rare Earth Elements
REO	Rare Earth Oxide
RM	Ringgit Malaysia
RQD	Rock Quality Designation
RSO	Rectified Skew Orthomorphic
SCR	Solid Core Recovery
SDG	Sustainable Development Goals
SDI	Sustainable Development Indicator
SEG	Samarium Europium Gadolinium
SKSPM	Surat Kelulusan Skim Pengendalian Melombong
SLO	Social Licence to Operate
SMCs	Subject Matter Consultants
SOP	Standard Operation Procedure
SPT	Surat Penilaian Teknikal
SPT-N	Soil Penetration Test-N
SS	Suspended Solids
SUB	Setiausaha Bahagian
SWR	Scheduled Waste Regulation
TCR	Total Core Recovery
TOR	Terms of Reference
TORAC	Terms of Reference Adequacy Check
TPA	Tonne Per Annum
TPM	Tonnes Per Month
TPTG	Timbalan Pengarah Tanah dan Galian
TPY	Tonnes Per Year
TRC	Technical Review Committee
TREO	Total Rare Earths Oxides
TSP	Total Suspended Particles
UAV	Unmanned Aerial Vehicle
UN	United Nations
UNEP	United Nation Environmental Program
USD	US Dollar
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
UV	Ultraviolet
WCED	World Commission on Environment and Development
WGS	World Geodetic System

ELEMENT SYMBOLS

Al	Aluminium
Ce	Cerium Element, LREE, Lanthanide Metal Group
Dy	Dysprosium Element, HREE, Lanthanide Metal Group
Er	Erbium Element, HREE, Lanthanide Metal Group
Eu	Europium Element, LREE, Lanthanide Metal Group
Fe	Iron
Gd	Gadolinium Element, LREE, Lanthanide Metal Group
Ha	Hectares
Ho	Holmium Element, HREE, Lanthanide Metal Group
K	Potassium, Alkali Metals Group
La	Lanthanum Element, LREE, Lanthanide Metal Group
Lu	Lutetium Element, HREE, Lanthanide Metal Group
Mg	Magnesium Element, Alkaline Earth Metal Group
N	Nitrogen Element, Non-Metal Group
Nd	Neodymium Element, LREE, Lanthanide Metal Group
NIB	Neodymium Iron Boron
NiMH	Nickel Metal Hydride
P	Phosphorus Element, Non-Metal Group
Pm	Promethium Element, LREE, Lanthanide Metal Group
Pr	Praseodymium Element, LREE, Lanthanide Metal Group
Ra	Radium Element, Alkaline Earth Metals Group
Sc	Scandium Element, Transition Metal Group
Sm	Samarium Element, LREE, Lanthanide Metal Group
Tb	Terbium Element, HREE, Lanthanide Metal Group
Th	Thorium Element, Actinide Metals Group
Tm	Thulium Element, HREE, Lanthanide Metal Group
U	Uranium Element, Actinide Metals Group
Y	Yttrium Element, Transition Metal Group
Yb	Ytterbium Element, HREE, Lanthanide Metal Group

UNITS

Bq/g	Becquerel per gram
kg/m^3	Kilogram per cubic meter
m^3/Y	Cubic meter per year
mSv/year	Micro Sievert/year (μSv/year)
ppm	Parts per million

PART 1
INTRODUCTION

INTRODUCTION ON NR-REE STANDARD OPERATING PROCEDURE

1.0

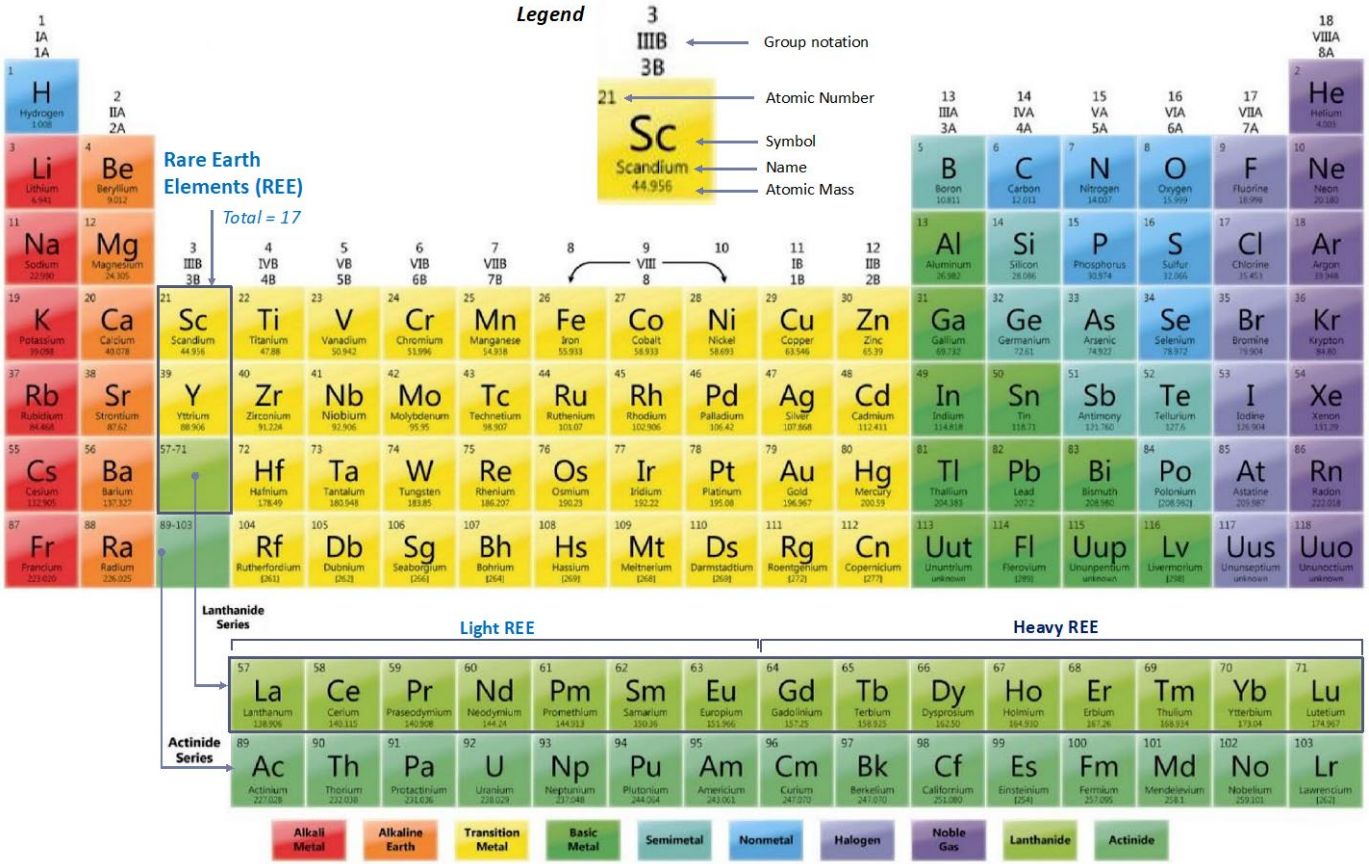
1.1 INTRODUCTION

Rare Earth Elements (REEs) group is a body of 17 elements comprising of the lanthanide group, atomic numbers (57–71), along with scandium (Sc, 21) and yttrium (Y, 39) as shown in **Figure 1-1**. REE are grouped into Light Rare Earth Elements (LREEs, atomic numbers 57–63), and Heavy Rare Earth Elements (HREEs, atomic numbers 64–71 plus yttrium 39). Scandium does not fall into the category of LREEs or HREEs due to their unique physical and chemical properties.

Rare Earth Elements (REEs) are considered to be critical raw materials due to the combination of their high importance in a range of low-carbon technologies and the concentration of supply, which is currently dominated by China. The REEs industry has a legacy of severe environmental impacts in its footprints related to the mining, beneficiation, and cracking process. The beneficiation process particularly from the mineral type REE has generated radioactive contaminated wastes which has in the past create legal and environmental issues with the authorities and the local community.

REEs are not found as native metals, but rather found in a range of minerals including silicates, carbonates, oxides, phosphates, and halides. REEs are not major rock forming elements, rather there are processes that concentrate specific REE distributions in residual fluids and are considered accessory minerals. Only three major REE bearing minerals are exploited commercially, namely bastnasite, monazite, and xenotime. In addition to those, REEs are extracted from ion-adsorption clay (IAC) deposits. Further elaboration on various aspects of REE are attached in **Appendix 1-1**.

IAC deposit is currently the focus source of REE in Malaysia. It is a new promising mineral resource with potentials as new economics for Malaysia. It is a non-radioactive source of Rare Earth Elements (NR-REE), mineable using sustainable mining method with RE Carbonate as the final product. Background details of NR-REE with its geological and metallurgical aspects are presented in **Appendix 1-2**.



Source: https://removeandreplace.com/wp-content/uploads/2015/09/The-Periodic-Table-Of-The-Elements.jpg

Figure 1-1: Rare Earth Elements in periodical table of the elements

This Standard Operating Procedure (SOP) of Non-Radioactive Rare Earth Elements (NR-REE) is for In-Situ Leaching (ISL) Mining Operation and Processing of IAC Deposit in Malaysia. The available REE resources and the RE Carbonate (REC) as the mine product are non-radioactive materials in view of their natural radioactivity concentration levels not exceeding 1.0 Bq/g or respectively 246.5 ppm of thorium or 80.9 ppm of uranium or 10 Bq/g potassium, as prescribed under Second Schedule, Atomic Energy Licencing Regulations (Radioactive Waste Management) 2011.

This SOP has been prepared based on the scoping information of the NR-REE mining development and operation in Malaysia and on actual on-going operation in other countries. The scoping information has been gathered to identify potential issues that may result from such development and operation and demonstrate due mitigation measures to address the said pertinent issues. Scoping is a critical activity which is required at the early stage in the SOP development process. It is designed to identify and assess the key technical and procedural issues of concerned that are required to be considered in detail during the IAC REE mining development and operation. Scoping ensured that matters which are of utmost importance are addressed in detail and the related valuable resources are not spent on non-significant matters.

This SOP for the NR-REE mining industry in Malaysia shall be used as reference and guideline by the stakeholders comprising of the Federal and State agencies, the industry, professional institutions, consultants, NGO and other individuals of interests. This SOP covers the cycle of NR-REE mining operation and processing. The concept of sustainable development application in mining industry, the vision of ‘Dasar Mineral Negara 2’ (DMN2), ‘Kerangka Pelan Transformasi Industri Mineral Negara 2021-2030’ (TIMM 2021-2030) and the relevant Sustainable Development Goals (SDGs) are the guiding principles in the preparation of this SOP.

1.2 NON-RADIOACTIVE RARE EARTH ELEMENTS (NR-REE)

All minerals and raw materials contain radionuclides of natural origin. For most human activities involving minerals and raw materials, the levels of exposure to these radionuclides are not significantly greater than normal background levels. Such exposures, while having been the subject of much research, are not of concern for radiation protection.

Minerals, like clay, mostly contain natural radionuclides from terrestrial origin, which are commonly referred as primordial radionuclides. Accordingly, it is also known as Naturally Occurring Radioactive Materials (NORM). There are over 50 occurring naturally radioactive elements, but the elements of main concern in radiometric studies are

Uranium-238 (^{238}U), Thorium-232 (^{232}Th) and Potassium-40 (^{40}K). The latter is common in potassium-rich rocks that cannot be related to concentrations of U and Th.

NORM is a radioactive material in its natural state containing no significant amounts of radionuclides other than those naturally occurring. Natural radioactivity from NORM in soils comes mainly from radionuclides in decay series of the three elements stated. The radioactivity level from the natural radionuclides is termed as background radiation which will depend on the amount of the radioactive materials in the environment. The background radiation can be high if the environment is disturbed or polluted, either from natural processes or man-made activities. The concentrations of NORM vary widely and are typically low in clay but higher in granite.

In Malaysia, NORM is a regulated substances under Atomic Energy Licencing Regulations (Radioactive Waste Management) 2011. The concentration limit of any material containing NORM that exceeding the specified limits, as prescribed under Second Schedule, Atomic Energy Licencing Regulations (Radioactive Waste Management) 2011, shall be classified as radioactive material. However, natural radioactivity of known ion-adsorption clay deposits at various locations in Malaysia exhibit radioactivity concentrations lower than the permitted prescribed level. As such, Radiological Impact Assessment (RIA) is not required in the mining and processing of the NR-REE IAC deposits as stipulated in Atomic Energy Licensing Act 1984, LEM/TEK/30 SEM.2, 1996 and LEM/TEK/58, 2009 for activity related to the disposal of Naturally Occurring Radioactive Materials (NORM) wastes from oil and gas industry or from mining industry.

The law of Malaysia with respect to the use and control of all sources of ionizing radiation, whether artificial or man-made is prescribed in the Atomic Energy Licensing Act, 1984 and its subsidiary legislations. A guideline is published by Atomic Energy Licensing Board (AELB) as mentioned in ‘Panduan Penentuan Perlesenan Aktiviti Melibatkan Bahan Radioaktif Semulajadi’ [Naturally Occurring Radioactive Material (NORM)]’ under Atomic Energy Licensing Act 1984.

1.3 CONTEXT OF THE SOP

This SOP for NR-REE mining in Perak, should be read and referred together with the relevant laws, regulations and guidelines pertaining to mining and mineral processing, and other statutory requirements. This SOP is specifically prepared to guide the stakeholders and consultant, to take all the necessary actions and prepare appropriate reports in compliance with the laws, regulations and guidelines. Compliance with the requirements set out in the laws and regulations shall fulfil the obligations of the

stakeholders, which comprise of the tenement holders, mine operators and other relevant authorities. The Government of Malaysia through Kementerian Tenaga Dan Sumber Asli (KeTSA) via Jabatan Mineral dan Geosains (JMG) have rationalized the planning process to make it more reflective to the scopes, functions, visions and aspirations of the nation, in line with the Pelan Transformasi Industri Mineral Negara 2021-2030 (TIM 2021-2030). This SOP, together with other statutory procedures therein, are produced to assist the stakeholders in planning and developing NR-REE mining.

1.4 SUSTAINABLE MINING AS GUIDING PRINCIPLE

The guiding principles for sustainable mining are the underlying commitment in the formulation of this SOP in the application process of mineral tenements, development, operations and closure of the entire project. The major guiding principles as stipulated in TIM 2021-2030, spelt out the universal needs and our nation's commitment towards fulfilling the mission and vision of sustainability in Malaysia's mining industry.

Based on these guiding principles, formulation of this SOP has taken into consideration the following objectives:

1) Responsible Mining – Mining that involves and respects all stakeholders, minimizes and takes account of its environmental impact, and prioritizes a fair division of economic and financial benefits;
2) Sustainable Mining – Application of sustainable development concept in mining development and operation;
3) Competency – Mining development and operation carried out by competent entities, technically and financially;
4) Value Added Products – Mining products of optimum value with multiplying impacts;
5) Adherence to High Standards of Industrial Norms – Best Management Practices(BMPs), self-regulatory, competent and professional human resources;
6) Control on Strategic Mineral Resources – Mineral security for strategic minerals in ensuring maximum benefits to the nation; and
7) Resource Efficiency – A mine has to be efficient in the way the resources are managed and extracted. Collaboration of mining engineers, geologists, metallurgists and other professional experts to optimize resource extraction.

List of criteria which needs to be taken into consideration, with respect to the proposed mining operation and capability of the prospect operators are as follows:

1) To consider area located within, near or in the vicinity of Environmental Sensitive Area (ESA) as defined by PLANMalaysia;

2) To comply with the zoning status of the area as prescribed under the gazetted Local Plan;
3) To verify the ability of the applicant with respect to their technical and financial in carrying out the proposed mine development and operation;
4) To comply with all the regulatory requirements as prescribed by various relevant laws, regulations and guidelines;
5) To prepare and implement appropriate mitigation measures, monitoring and audits involving the mine development and operation;
6) To provide and comply to all the minimum buffer zone requirements as prescribed in various guidelines;
7) To prepare and implement an approved rehabilitation plan for the mining project; and
8) To ensure the availability third party insurance policy for any untoward incidences involving the mining development and operation.

1.5 FRAMEWORK OF THE SOP

This SOP is a concise document, and it shall provide ample and relevant information needed by the industry and the regulatory agencies, for consideration, during the pre-mining, mining and the post-mining phases of a related project. This SOP has been prepared based on various practices, researches, studies and data on NR-REE mining development and operation. It also provides a listing and description of the approvals needed for the mining and processing to proceed.

This SOP focuses on the checklists, processes, and also where relevant, designated flowcharts of the process activities that are carried out at all stages of the planning, development and operation of a project. Unpublished documents and detailed data are presented in the appendices. As this SOP may utilise common practices of other similar mining practices, appropriate references and a listing of organizations consulted are included, where necessary. The public availability of data and studies utilised, shall also be indicated. Wherever practical, maps, flow diagrams, charts and photographs, directly referred to in this SOP are also included.

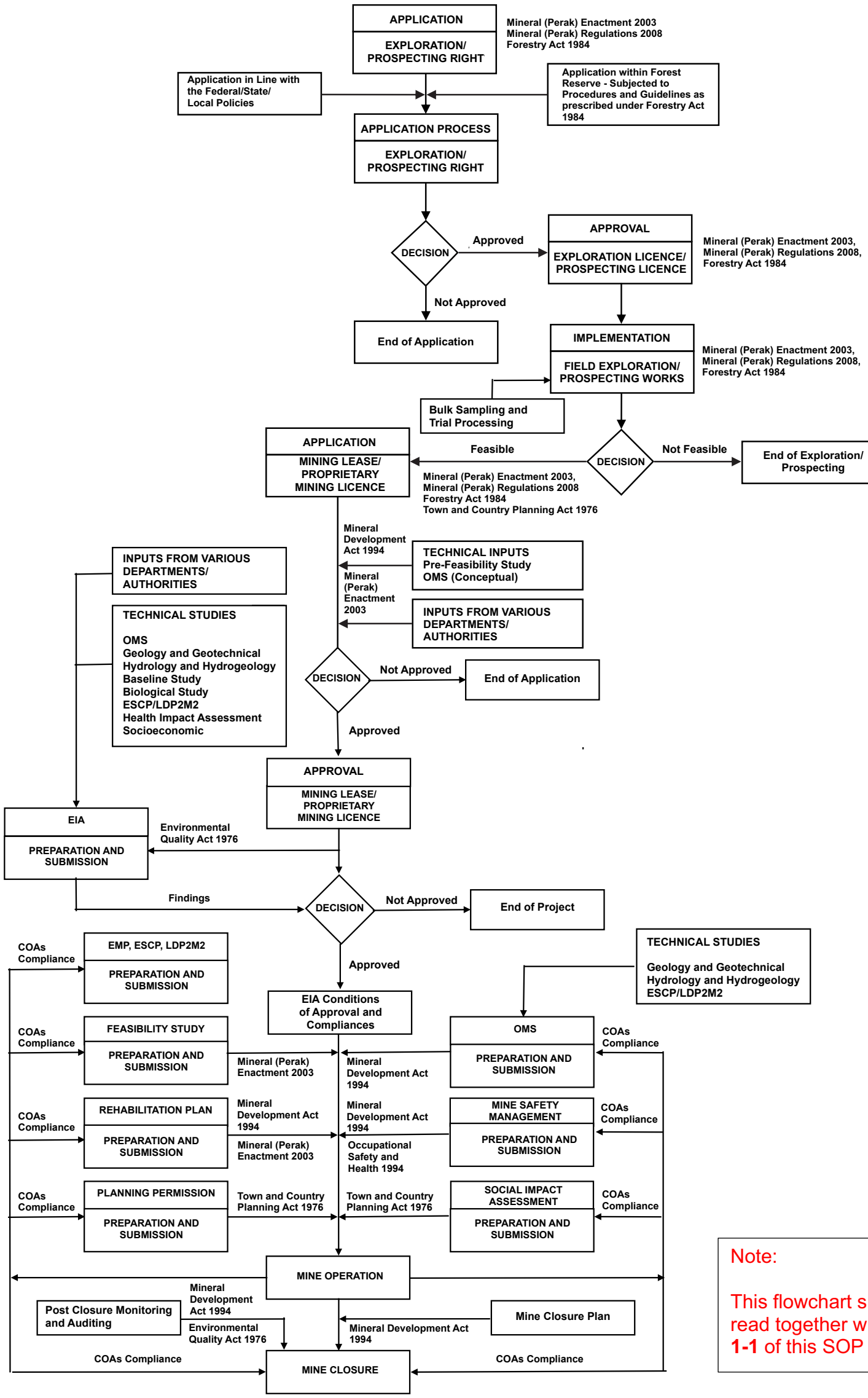
The introduction also includes a brief description on the aspect of sustainable mining, which forms the underlying principle in the formulation of this SOP of NR-REE mining. The main body of this SOP also includes detailed description of the NR-REE IAC deposits, In-Situ Leaching (ISL) mining method, which shall be utilised in the NR-REE extraction, and the processing to produce RE carbonate as the final product of the operation.

An overview of the Malaysian mining history, where Malaysia had been the world leading producer of tin during the late 18th century up to the middle of the 20th century, is as attached in **Appendix 1-3,** as reflection of the past issues which led to the formulation of this SOP. The newly unveiled TIM 2021–2030 is part of the government's effort to rejuvenate the mineral industry in order to capitalize on the available minerals in Malaysia, including NR-REE as a new source of economy.

1.6 DOCUMENTATION OF THE SOP

With the documentation of this SOP, it will allow the NR-REE mining industry and all the stakeholders to systematize their processes, keep all team members and other stakeholders on the same page at all times, and move forward in a singular, cohesive manner. Perhaps the best way to illustrate the importance of developing an SOP documentation is to consider the negative impact of not doing so. With SOP in place, adherence to best practices regarding all organizational processes is not merely a suggestion, but a mandate.

A flowchart of NR-REE mining project activities, with relevant approvals, studies and requirements is depicted in **Figure 1-2**. The flowchart reflects the overall scope of tasks to be completed during the mining life cycle. This SOP scope shall be identified using the said flowchart. **Table 1-1** presents list of statutory approvals at various stages of the planning, development and operation of IAC for NR-REE mine. This acts as a checklist of the mandated requirement as stipulated in this SOP.



Note:

This flowchart should be read together with **Table 1-1** of this SOP

Figure 1-2: flowchart of REE mining project activities with relevant approvals and studies requirements

Table 1-1: List of study and technical report requirements at various stages of the planning, development and operation of IAC NR-REE mine (To be read together with Figure 1-2)

Project stages and statutory requirements	Statutory Requirements				SOP references	Authority approval	Remarks
	Approvals/ Compliances	Source of authority	Study and report requirements	Time of Submission			
Pre-Operation							
Application of Exploration Licence (EL)/Prospecting Licence (PL)	Issuance of PL/EL	✧ PL - Section 41, Mineral (Perak) Enactment 2003 ✧ EL - Section 48(1), Mineral (Perak) Enactment 2003	✧ PL - Form 5A Regulation 26(1), Mineral (Perak) Regulations 2008 ✧ EL - Form 5B Regulation 32(1), Mineral (Perak) Regulations 2008	During application	Section 2.2	PTG, JMG	
Field Exploration		✧ Section 41(7)(a), Mineral (Perak) Enactment 2003 ✧ Section 42(1)(a), Mineral (Perak) Enactment 2003	Quarterly annual and final reports ✧ EL - Regulation 29, Mineral (Perak) Regulations 2008 ✧ PL - Regulation 30, Mineral (Perak) Regulations 2008	Upon approval and within PL/EL period	Section 2.2.3 and Section 2.2.4	PTG, JMG	
			Bulk sampling and Trial Processing ✧ Section 54(2), Mineral (Perak) Enactment 2003 ✧ Section 13 and Section (19), Mineral Development Act 1994	Within PL/EL period	Section 2.2.5	PTG, JMG	Subject to approval to PTG and JMG
Application of Mining Lease (ML)/Proprietary Mining Licence (PML)	Issuance of ML/PML	✧ ML - Section 63, Mineral (Perak) Enactment 2003 ✧ PML - Section 81, Mineral (Perak) Enactment 2003	Submission of Form and supporting documents ✧ ML - Regulation 41, Mineral (Perak) Regulations 2008 ✧ PML - Regulation 50, Mineral (Perak) Regulations 2008	During application	Section 2.3 and Section 2.4	PTG, JMG	
			Pre-feasibility Report ✧ ML - Regulation 41, Mineral (Perak) Regulations 2008 ✧ PML - Regulation 50, Mineral (Perak) Regulations 2008	During application	Section 4.3 and Section 4.4	PTG, JMG	
			Operational Mining Scheme (OMS) – Conceptual ✧ ML - Regulation 41, Mineral (Perak) Regulations 2008 ✧ PML - Regulation 50, Mineral (Perak) Regulations 2008 ✧ Section 10(1), Mineral Development Act 1994	During application	Section 5.0	JMG	
	Environmental Impact Assessment (EIA)	✧ Section 34A, Environmental Quality Act 1974, EIA Oder 2015	As prescribed in the following: ✧ Environmental Impact Assessment Guidelines in Malaysia (JAS 2016) ✧ Environmental Impact Assessment Guidelines for Mining and Quarrying (JAS 2018)	During application	Section 6.0	JAS, JPS	List of studies and reports requirements – Figure 1-2

Table 1-1: List of study and technical report requirements at various stages of the planning, development and operation of IAC NR-REE mine (To be read together with Figure 1-2) (Continued)

Project stages and statutory requirements	Statutory requirements				SOP references	Authority approval	Remarks
	Approvals/ Compliances	Source of authority	Study and report requirements	Time of submission			
		✧ Section 34A, Environmental Quality Act 1974, EIA Oder 2015	Erosion and Sediment Control Plan (ESCP) / Land Disturbing Potential Pollution and Mitigation Measures (LDP2M2) – Conceptual	During application	Section 5.11 dan Section 7.3	JAS, JPS	
Operation							
Application of Operational Mining Scheme (OMS)	OMS	✧ Section 10(1), Mineral Development Act 1994	✧ Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 ✧ Guidelines on the Preparation of OMS (JMG 2019) ✧ Circular of JMG Director General – Circular No. 1/2018, Dated 5 Mar 2018 and Circular No. 1/2020, dated 1 July 2020	Before commencement of mining operation	Section 5.0	JMG	
Environmental Management Plan (EMP)	EMP	✧ Section 34A, Environmental Quality Act 1974	✧ Environmental Impact Assessment Guidelines in Malaysia (2016) ✧ Environmental Impact Assessment Guidelines for Mining and Quarrying (2018)	Before commencement of mining operation	Section 7.0	JAS	Including implementation
	ESCP / LDP2M2	✧ Section 34A, Environmental Quality Act 1974	✧ MSMA (Second Edition) (JPS 2012) ✧ Guidelines for Erosion and Sediment Control in Malaysia (JPS 2010) ✧ Preparation of Land-Disturbing Pollution Prevention and Mitigation Measures (LDP2M2s) (JAS 2017)	Before commencement of mining operation	Section 5.11 dan Section 7.3	JAS, JPS	Including implementation
Mine Rehabilitation	Mine Rehabilitation Plan	✧ Section 64 and Section 126, Mineral (Perak) Enactment 2003, ✧ Regulation 3(1)(s), Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007	Rehabilitation Plan	Before commencement of mining operation	Section 8.0	JMG	Including implementation
Mine Safety	Mine Safety Management	✧ Mineral Development Act 1994 ✧ Factory and Machinery Act 1967 ✧ Occupational Safety and Health 1994	Mine Safety Management	Before commencement of mining operation	Section 9.0	JMG, JKKP	
		✧ Section 64(1)(a) and Section 73(1), Mineral (Perak) Enactment 2003	Feasibility Report	Upon issuance of ML/PML	Section 4.4	JMG, PTG	
		✧ Section 64 and Section 126, Mineral (Perak) Enactment 2003; Regulation 3(1)(s) ✧ Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007	Rehabilitation Plan	Upon issuance of ML/PML	Section 8.0	JMG	

Table 1-1: List of study and technical report requirements at various stages of the planning, development and operation of IAC NR-REE mine (To be read together with Figure 1-2) (Continued)

Project stages and statutory requirements	Statutory Requirements				SOP references	Authority approval	Remarks
	Approvals/ Compliances	Source of authority	Study and report requirements	Time of submission			
Mining Operation and Processing	Operation	✧ Sections 12, 13, 14 and Section 15 Mineral Development Act 1994 ✧ Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 ✧ Section 34A, Environmental Quality Act 1974	Compliances on various operational conditions of approval	Throughout the mine life	Section 5.0 and Section 10.0	JMG	
Planning Permission (KM)	Planning approval	✧ Section 19, Town and Country Planning Act 1976 – No person other than the local authorities, shall commence, undertake, or carry out any development unless planning permission in respect of the development has been granted to him under section 22. ✧ Checklist – Form A, First Schedule Regulation 2(1).	Compliances on various operational conditions of approval	Once, before the commencement of the project	Section 10.0, Table 10-1	PLANMalaysia / Local Authority	
Social Impact Assessment (SIA)	Planning approval	✧ Development projects (Category 3) other than specified under Sections 20B(1), 20B(2), 22(2A), Town and Country Planning Act (Amendment) 2017 which are considered to have clear social impact determined by PLANMalaysia@State or the Local Authorities.	Compliances on various operational conditions of approval	Once, before the commencement of the project	Section 10.0, Table 10-1	PLANMalaysia / Local Authority	
Post Mining Operation							
Mine Closure Plan	Abandonment plan	✧ Section 20, Mineral Development Act 1994	Abandonment Plan	Prior to the completion of mining operation	Section 14.0	JMG, JAS	

PART 2
PRE-MINING OPERATION PHASE

APPLICATION OF MINERAL TENEMENTS 2.0

2.1 INTRODUCTION

REE is a mineral by definition, as prescribed in Section 2(1) of the Mineral (Perak) Enactment 2003. Due to that, its dealings are subjected to provisions of the said governing law particularly on matters related to the mineral tenements. Mineral tenements as defined in the same section as a fossicking licence, dulang licence, individual mining licence, prospecting licence, exploration licence, mining lease, proprietary mining licence, or any of them for the purpose of exploration or mining of minerals or mineral ores.

Application for a mineral tenement commences with a study on the availability of the targeted mineral on the area of concerned. Preliminary desktop study on the mineral potential of the area, forms the basis for an application for appropriate mineral tenements to be made. A number of considerations with respect to the prevailing guiding principles in mining sustainability is necessary in ensuring the proposed NR-REE mining operation and processing shall diligently be carried out.

2.2 APPLICATION OF PROSPECTING LICENCE (PL) OR EXPLORATION LICENCE (EL)

Mineral exploration is the first activity essential for any mining development project. In Malaysia, the provision for such activities is prescribed in Section 41, Mineral (Perak) Enactment 2003. The differences between PL and EL are as provided in Section 48(1), where for a PL granted under the said Enactment, the approved area shall not exceed 400 ha, while for an EL, shall exceed 400 ha but should not exceed 20,000 ha.

Whenever the PL/EL holder discovers potential NR-REE deposits, and decides to exploit the deposits, then this SOP shall apply. Details pertaining to the procedure and checklist of the EL and PL applications are described as follows.

2.2.1 Procedure on the application of PL/EL

Details pertaining to the process checklist of the PL/EL applications are as tabulated in **Table 2-1** with the relevant flowchart depicted in **Figure 2-1.** In view that application for

the PL or EL shall be the first important step towards breaking a new ground for NR-REE mining and development, it is of paramount importance that the area under application has been properly defined and identified, particularly on the existence of the targeted REE. It is thus extremely important for an appropriate and structured study be conducted on the area, which shall form a basis for the said application to be made. The brief report shall be attached as part of the application submission, and should contain, but not limited to the information as listed in **Table 2-2**.

Table 2-1: Checklist on the application of PL/EL

No.	Documents	Remarks
Section 41, Mineral (Perak) Enactment 2003		
1.	Application Form (Form 5A or Form 6A) – 6 Copies	
2.	Profile of the Applicant	
	✧ Company Incorporated under the Relevant Companied Act	
	✧ Entity established under various laws	
	✧ Company/entity permissible to hold PL/EL	
	✧ Copy of identity card (individual application)	
3.	Memorandum and Article of Association/Establishment Incorporation	
4.	Copy of documents (Company Incorporated under Companies Act 1965)	
	✧ Certificate of company registration	
	✧ Form 13 (Change of Company Name) – If relevant	
	✧ Form 24 (Information on Share Holding)	
	✧ Form 44 (Information on the Company Registered Office)	
	✧ Form 49 (Information on BOD, Managers and Company Secretary)	
	Copy of documents (Company Incorporated under Companies Act 2016)	
	✧ Certificate of incorporation (Section 17)	
	✧ Notice of registration (Section 15)	
	✧ Particulars of company (Section 14)	
	✧ Appointment of First Company Secretary (Section 58)	
5.	Plan of application area (Scale – 1:50,000) – 6 Copies)	
6.	RE IAC Deposits Potential Report	Refer to Table 2-2
7.	Registration Fee for the Application	
8.	Technical comments from relevant state authorities	
	✧ Jabatan Mineral dan Geosains (JMG)	
	✧ Jabatan Alam Sekitar (JAS)	
	✧ Jabatan Perhutanan Semenanjung Malaysia (JPSM)	
	✧ Jabatan Pengairan dan Saliran (JPS)	
	✧ Pejabat Tanah Daerah	
	✧ Jabatan Perancangan Bandar dan Desa (PLANMalaysia)	

Table 2-1: Checklist on the application of PL/EL (Continued)

No.	Documents	Remarks
	✧ Pihak Berkuasa Tempatan (PBT)	
9.	Consideration by the State Mineral Resource Committee (JSMN)	
10.	JSMN Representation to the EXCO for Consideration	
11.	EXCO consideration and decision	
12.	Upon approval – Issuance of PL/EL by PTG	

2.2.2 Right and obligation of PL/EL holder

Upon approval of the PL/EL, the licence holder has certain statutory compliances, which need to be fulfilled as prescribed in Section 42, Mineral (Perak) Enactment 2003. The licensee is expected to carry out exploration works within the approved area, utilizing appropriate exploration practices suitable for NR-REE as the targeted mineral.

A checklist that details the rights and obligations of the PL/EL holder as prescribed in Section 49, Section 52 and Section 55 of the Mineral (Perak) Enactment 2003 is as summarized in **Table 2-3**.

2.2.3 Reporting and other commitments of PL holder

As stipulated in Regulation 29, Mineral (Perak) Regulations 2008, subject to Section 41(7)(a) and Section 42(1)(a), Mineral (Perak) Enactment 2003, all PL holders shall submit and make available information to the Pengarah Tanah dan Galian (PTG) Perak, items as listed in **Table 2-4**.

2.2.4 Reporting and other commitments of EL holder

As stipulated in the Regulation 30, Mineral (Perak) Regulations 2008, subject to Section 41(7)(b) and Section 42(1)(b) of the Mineral (Perak) Enactment 2003, EL holders shall submit and make available information to the PTG Perak, items as listed in **Table 2-5**.

2.2.5 Bulk sampling and trial processing

Section 54(2), Mineral (Perak) Enactment 2003, stipulates that the holder of an EL shall be entitled to do (1) bulk sampling; and (2) trial processing, of any mineral ore in the exploration area, not exceeding such limit as may be specified in the licence or as may be prescribed. Section 54(4) stipulates that the expressions “bulk sampling” and “trial processing” mean the collection and treatment respectively, of a representative portion of the deposit, solely for the purpose of determining the projected viability of developing the deposit.

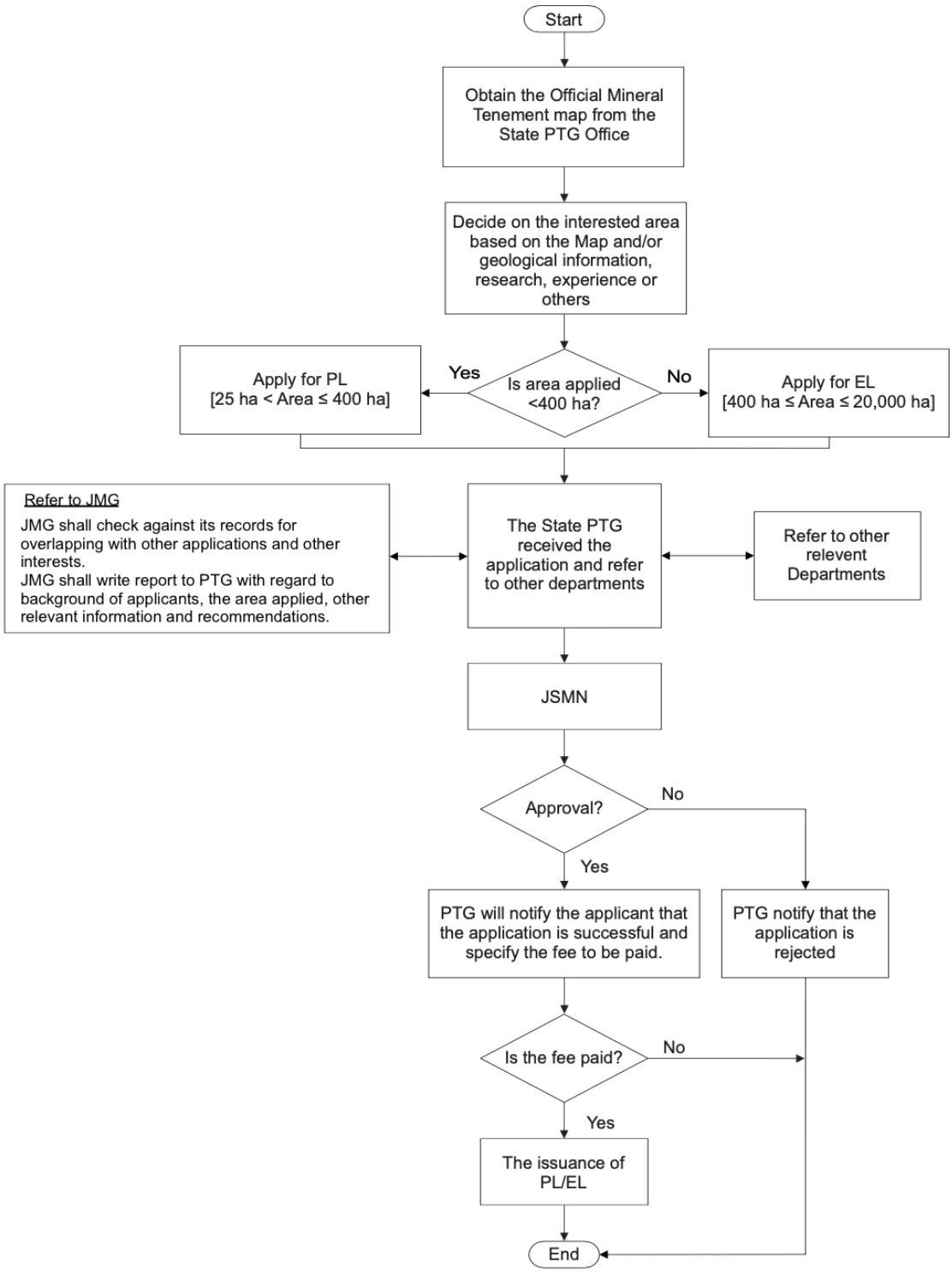


Figure 2-1: Flowchart for the application of PL or EL

Table 2-2: Content of brief report for NR-REE IAC deposit potential

No.	Information	Remarks
1.	Methodology in identifying the area under application.	
2.	General geology and mineralization description of the area.	
3.	Geomorphology of the area.	
4.	Mining history, if any, on the area, adjoining area or in its vicinity.	

Table 2-3: Rights and obligations of PL/EL holder

No.	Documents	Remarks
Sections 49, 52 and Section 55, Mineral (Perak) Enactment 2003		
1.	To obtain access and to enter the prospecting or exploration area.	
2.	To explore on an exclusive basis for any mineral within the limits of the prospecting or exploration area.	
3.	To obtain samples within the limits of the prospecting or exploration area and to remove such samples.	
4.	To use water, sand and gravel, road, canal and river as required for exploration within the limits of the prospecting or exploration area.	
5.	PL and EL holder may apply for and be granted on a priority basis one or more ML in respect of any part of the land under the PL and EL.	
6.	PL and EL holders shall commence field exploration within three (3) months and twelve (12) months from the issuance date of the licences respectively.	
7.	PL and EL holder to notify the Director General of JMG on the commencement of the exploration.	
8.	Field exploration within the prospecting or exploration area may include airborne geophysical and geomagnetic surveys and other related surveys.	
9.	The PL/EL shall continue to remain in force until the application is determined but shall be deemed to have expired on the date on which the said application is refused.	

Table 2-4: Reporting and other commitments of PL holder

No.	Documents	Remarks
Regulation 29, Mineral (Perak) Regulations 2008, subject to Section 41(7)(a) and Section 42(1)(a), Mineral (Perak) Enactment 2003		
1.	Five (5) copies of a quarterly progress report as prescribed in Format 1 of the Fourth Schedule at the end of each quarter of a calendar year.	
2.	Five (5) copies of a final report as prescribed in Format 2 of the Fourth Schedule on or before the expiry date of the licence.	

Table 2-4: Reporting and other commitments of PL holder (Continued)

No.	Documents	Remarks
3.	Expenditure during each year, the amounts prescribed in the Fifth Schedule;	
4.	To submit annually, five (5) copies of an annual work expenditure and relinquishment statement as prescribed in Form 5D of the Third Schedule on or before the anniversary date of the licence.	

Table 2-5: Submission of information to PTG Perak

No.	Documents	Remarks
Regulation 30, Mineral (Perak) Regulations 2008, Subject to Section 41(7)(b) and Section 42(1)(b) of the Mineral (Perak) Enactment 2003		
1.	Five (5) copies of a quarterly progress report as prescribed in Format 3 of the Fourth Schedule at the end of each quarter of a calendar year.	
2.	Five (5) copies of a final report as prescribed in Format 4 of the Fourth Schedule on or before the expiry date of the licence.	
3.	Five (5) copies of a final report as prescribed in Format 5 of the Fourth Schedule on or before the expiry date of the licence.	
4.	Expenditure during each year, the amounts prescribed in the Sixth Schedule.	
5.	To submit annually, five (5) copies of an annual work expenditure and relinquishment statement as prescribed in Form 6D of the Third Schedule on or before the anniversary date of the licence.	

However, in view on the nature of the NR-REE IAC deposit and the ISL mining method to be used, it is quite challenging for the trial processing to be appropriately implemented on site. Thus, under this SOP, trial processing shall only be permitted to be carried out at an approved laboratory. No trial processing using ISL mining method (on site) for the NR-REE IAC deposit is permitted. The bulk sampling and trial processing to be conducted shall observe certain obligations as listed in **Table 2-6**.

Table 2-6: Bulk sampling and trial processing commitments

No.	Documents	Remark
Section 54(2) and Section 54(4), Mineral (Perak) Enactment 2003 (Derived)		
1.	To comply and observe all relevant law, regulation and guidelines in relation to the NR-REE exploration, bulk sampling and trial processing.	
2.	To propose operational scheme for the relevant activities.	
3.	To describe the technical details of the operation.	
4.	To list all targeted objectives of the exercise.	

Table 2-6: Bulk sampling and trial processing commitments (Continued)

No.	Documents	Remark
5.	To propose an Environmental Management Plan (EMP) for the proposed operation.	
6.	Reporting on the findings of the bulk sampling and trial processing.	
7.	Appropriate professionals and consultants to be involved in the exercise.	
Administrative Requirements		
1.	To apply to PTG for proposed bulk sampling/trial processing and PTG to seek JMG's technical advice.	
2.	To provide details of the laboratory where the trial processing shall be carried out.	

2.3 APPLICATION OF MINING LEASE (ML)

ML is one of the mineral tenements, which needs to be obtained before any mining operation may be carried out. In Malaysia, the provisions related to ML are prescribed in Section 63, Mineral (Perak) Enactment 2003. Details pertaining to the checklist and procedure of the ML application are described in **Table 2-7** and **Table 2-8** respectively, with the process flowchart depicted in **Figure 2-2**.

Table 2-7: Checklist on the application of ML

No.	Documents	Remark
1.	Application Form (Form 8A) – 6 Copies	
2.	Profile of the Applicant	
	✧ Company incorporated under the relevant companies Act.	
	✧ Entity Established under various laws.	
	✧ Company/Entity permissible to hold ML/PML.	
	✧ Copy of identity card (Individual application).	
3.	Memo and Article of Association/ Establishment/Incorporation.	
4.	Copy of documents (Incorporated under Companies Act 1965).	
	✧ Certificate of Company Registration.	
	✧ Form 13 (Change of Company Name) – If relevant.	
	✧ Form 24 (Information on Share Holding).	
	✧ Form 44 (Information on the Company Registered Office).	
	✧ Form 49 (Register of Directors, Managers and Company Secretary).	
	Copy of documents (Incorporated under Companies Act 2016).	
	✧ Certificate of incorporation (Section 17).	
	✧ Notice of registration (Section 15).	
	✧ Particulars of company (Section 14).	

Table 2-7: Checklist on the application of ML (Continued)

No.	Documents	Remark
	✧ Appointment of First Company Secretary (Section 58)	
5.	Location plan of area under application (Scale – 1:50,000) – 6 Copies).	
6.	Pre-feasibility report including proposed rehabilitation plan – 6 Copies).	
7.	Copy of the approved exploration/prospecting licence on the area.	
9.	Technical Comments from various relevant state authorities.	
	✧ JMG	
	✧ JAS	
	✧ JPSM	
	✧ JPS	
	✧ JKKP	
	✧ Pejabat Tanah Daerah	
	✧ PLANMalaysia	
	✧ PBT	
10.	Consideration by JSMN.	
11.	JSMN representation to the EXCO for consideration.	
12.	EXCO consideration and decision.	
13.	Upon approval	
	✧ Carry out cadastral survey by the Applicant.	
	✧ Issuance of ML by PTG.	
14.	As NR-REE mining is classified as large scale operation (as Section 2 Mineral (Perak) Enactment 2003). Applicant needs to carry out:	
	✧ EIA	
	✧ Feasibility Study	
	✧ Rehabilitation Plan	
15.	Upon Approval of Items 14, holder may apply for OMS.	

Table 2-8: Work procedure on the application of ML

No.	Subject	Action	Compliance
1.	Submission of completed application form together with all the relevant documents.	Applicant/Officially appointed agent.	
2.	Application received, check on documents and record, to use checklist in checking.	Principal Assistant Administrator/Assistant Administrator.	
3.	Applicant to pay RM200 as application fee.	Assistant Administrator (Mineral)	

Table 2-8: Work procedure on the application of Mining Lease (ML) (Continued)

No.	Subject	Action	Compliance
4.	Issuance of acknowledgement letter on the application received and to seek comments from the relevant technical departments.	Assistant Administrator (Mineral)	
5.	Distribution for marking the application area on the appropriate plan and to prepare report together with certified plan.	Principal Assistant PTG/ Draftsman/Assistant Land Officer	
6.	Received comments from technical departments.	Assistant PTG/Principal Assistant PTG (Mineral)	
7.	Presentation of the application at JSMN meeting for decision – approve/reject/ postpone. Confirmation on mineral reserve and suitability of the rehabilitation plan.	JSMN	
8.	Preparation of EXCO paper.	Assistant PTG/Principal Assistant Administrative Officer/Assistant Administrative Officer	
9.	Checking and signing of the EXCO paper.	Assistant Land Officer/ Deputy PTG/PTG/YAB MB	
10.	Application submitted to the EXCO secretariat.	Principal Assistant Administrator Officer.	
11.	Presentation of the application at EXCO meeting for decision – approve/reject/ postpone by the State Authority.	EXCO/State Authority	
12.	Application file with decision to be forwarded by MMK secretariat to PTG.	MMK/PTG	
13.	Release of the decision to the applicant.	Deputy PTG/Assistant PTG/Principal Assistant PTG/PTG	

2.4 APPLICATION OF PROPRIETARY MINING LICENCE (PML)

Mining of mineral on an alienated land, may be carried out upon an approval of PML by the State Authority on the said area, as provided under section 81(1), Mineral (Perak) Enactment 2003. Details pertaining to the checklist of a typical PML application are as listed in **Table 2-9,** while the procedure is similar to the ML application as shown in **Table 2-8**. The process flowchart on the application of PML is as shown in **Figure 2-3**.

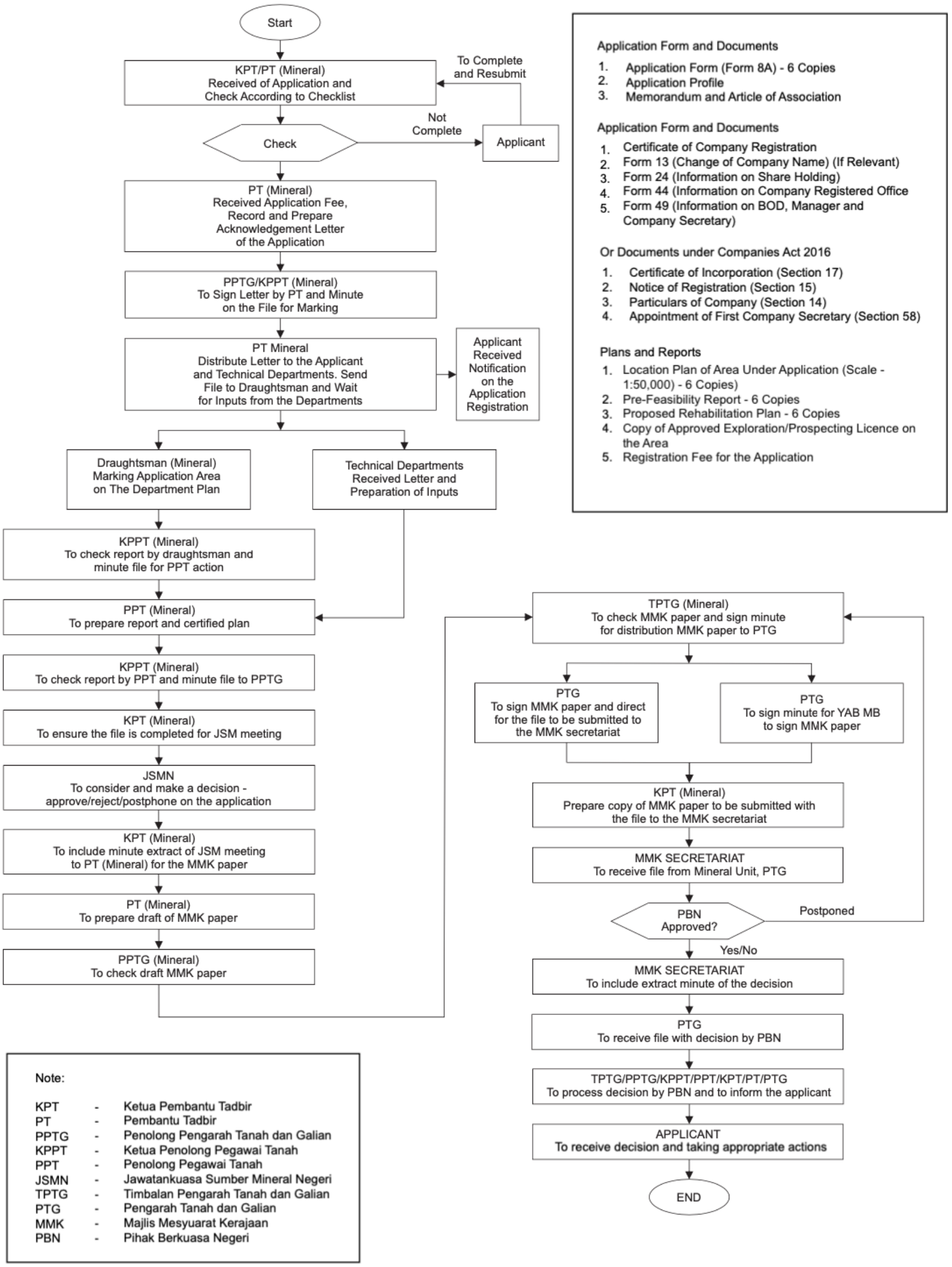


Figure 2-2: Flowchart of the application process for ML

Table 2-9: Checklist on the application of Proprietary Mining Licence (PML)

No.	Documents	Remark
Section 81(1), Mineral (Perak) Enactment 2003 (Derived)		
1.	Application Form (Form 9A) – Six (6) copies	
2.	Profile of the Applicant	
	✧ Company incorporated under the relevant companies Act.	
	✧ Entity established under various laws.	
	✧ Company/entity permissible to hold ML/PML.	
	✧ Copy of identity card (individual application).	
3.	Memo and article of association/establishment /incorporation	
4.	Copy of documents (Company Incorporated under Companies Act 1965).	
	✧ Certificate of company registration	
	✧ Form 13 (change of company name) – If relevant	
	✧ Form 24 (Information on share holding)	
	✧ Form 44 (information on the company registered office)	
	✧ Form 49 (Information on BoD, Managers and Company Secretary)	
	Copy of documents (Company Incorporated under Companies Act 2016).	
	✧ Certificate of incorporation (Section 17)	
	✧ Notice of registration (Section 15)	
	✧ Particulars of company (Section 14)	
	✧ Appointment of first company secretary (Section 58)	
5.	Location plan of area under application (Scale – 1:50,000) – Six (6) copies).	
6.	Pre-feasibility report including proposed rehabilitation plan – Six (6) copies)	
7.	Copy of the approved exploration/prospecting licence on the area.	
8.	Registration fee for the application.	
9.	Technical comments from various relevant state authorities.	
	✧ JMG	
	✧ JAS	
	✧ JPSM	
	✧ JPS	
	✧ JKKP	
	✧ Pejabat Tanah Daerah	
	✧ PLANMalaysia	
	✧ PBT	
10.	Consideration by JSMN	
11.	JSMN Representation to the EXCO for Consideration	
12.	EXCO consideration and decision	

Table 2-9: Checklist on the application of Proprietary Mining Licence (PML) (Continued)

No.	Documents	Remark
13.	Upon Approval	
	✧ Carry out cadastral survey by the applicant	
	✧ Issuance of PML by PTG	
14.	As NR-REE mining is classified as large scale operation (as Section 2 Mineral (Perak) Enactment 2003). Applicant needs to carry out:	
	✧ EIA	
	✧ Feasibility study	
	✧ Rehabilitation plan	
15	Upon approval of Items 14, holder may apply for OMS.	

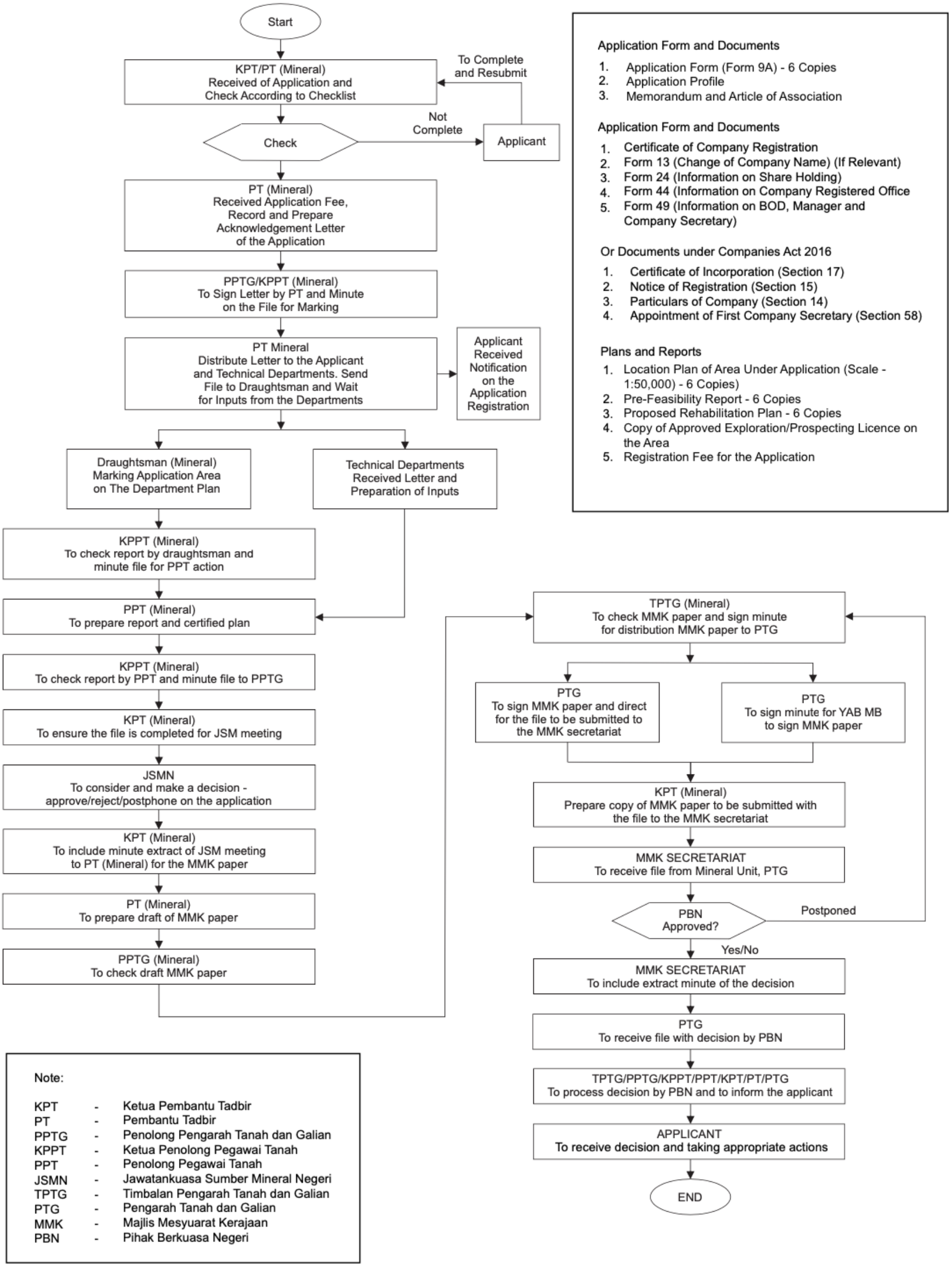


Figure 2-3: Flowchart of the application process for PML

EXPLORATION AND RESERVE EVALUATION

3.0

3.1 INTRODUCTION

Mineral exploration covers the initial phases of a prospective life of a mine. At this stage of the mining cycle, there are no guarantees that a mine will eventually commence. In most cases, there will be environmental and social impacts that will need to be addressed including, amongst others, access, disposal of wastes, and community concerns and expectations.

Mineral exploration and evaluation techniques may range from the most environmentally benign, such as remote sensing from satellites, to the more invasive, such as close-spaced intensive drilling. Environmental planning and management offer their greatest benefit when preventing, or at least minimizing environmental impacts by:

1) Promoting environmental awareness within exploration companies.
2) Educating and training employees and contractors.
3) Developing and applying industry codes of practice.

The application of high standard environmental management practices in exploration is essential to ensure that such activities are properly controlled, with the essential protection of environmentally sensitive areas and community concerns shall be effectively addressed. Several guidelines (local or international) are openly available to assist mining exploration companies to achieve outstanding output levels from best practices.

3.2 EXPLORATION PLANNING AND PROGRAM

As a start for any exploration work, information on the area under study should be made available from various reliable sources, such as local mineral potential plan, published memoirs and maps from JMG or other institutions, as well as evidence from previous or current workings or site investigations in the area. Surface sampling and low density drilling are most commonly used, throughout the site, to establish the presence, or otherwise, a potentially economic horizon at more than one site, before committing to more detailed investigations at the most prospective location.

3.2.1 Statutory governance of mineral exploration works

As elaborated in **Table 1-1**, the governing law pertaining to mineral exploration and prospecting in Perak are the Mineral (Perak) Enactment 2003 and the Mineral Development Act 1994 together with their respective regulations. List of guidance documents which need to be consulted together with Mineral (Perak) Enactment 2003 and the Mineral Development Act 1994 are as shown in **Table 3-1**.

Table 3-1: List of guidance documents related to mineral exploration

No.	Laws, Regulations and Guidelines	Scope
1.	Section 49, Section 52 and Section 55, Mineral (Perak) Enactment 2003	Conduct and general management
2.	Mineral Development (Safety in Exploration and Surface Mining) Regulations 2014	Safety management
3.	Garis Panduan Eksplorasi Unsur Nadir Bumi, JMG.GP.20 (JMG 2015)	Exploration guidelines and reporting
4.	Regulation 29 and 30, Mineral (Perak) Regulations 2008	Statutory stipulated reporting period
5.	Section 113(a) and Section 113(b), Mineral (Perak) Enactment 2003	Environment

3.2.2 Geological and structural characteristics of NR-REE deposit

The geological and structural characteristics of the proposed mining area needs to be determined and described. The distribution area of acidic intrusive rocks if any, and the exposed rock strata shall be fully defined. Typically, in Malaysia, with reference to the process of continuous weathering erosion cycle, the weathering rate is usually greater than the denudation. This shall result, in the forming a relatively gentle hilly topography, which is advantageous to chemical weathering. This makes the surface acidic intrusive rocks to develop into a large-scale weathered crust(s). General overview of the geological and structural characteristics of NR-REE deposit is attached in **Appendix 3-1**. Detailed information which needs to be provided pertaining to the geological and structural characteristics of NR-REE deposit of the area applied, are listed in **Table 3-2**.

3.2.3 Ore characterization

IAC are weathered crusts, elution-deposited REE ores, which consist of aluminosilicate clay minerals (kaolinite, illite, smectite) formed through in-situ lateritic weathering of NR-REE-rich host rocks. In these low-grade secondary ore deposits, the available NR-REE cations are mainly adsorbed onto the aluminosilicates as a result of the large surface area to volume ratio, and negatively charged surfaces of these minerals.

Table 3-2: Information on the geological and structural characteristics of NR-REE deposit

No.	Information	Notes
1.	Description of geological formation of the NR-REE deposit and the ore-bearing horizon of the weathering crust(s) ion-adsorbed NR-REE deposits in this area.	
2.	Indicate the boundary between the upper and lower layers of ore body of the NR-REE deposits.	
3.	Description on the vertical stratification of ore-bearing weathering crust of the area.	
4.	Description of main component of the semi-weathered layer of the ore body.	

The distribution and chemical state of NR-REE in IAC deposits, can be complex where NR-REE can also sorb onto Fe and Mn oxides or organic fractions; they can be substitutes for cations such as K^+ or Ca^{2+}; they can precipitate in the form of secondary insoluble oxides, hydroxides or polymeric organometallic compounds; or can be trapped in residual refractory magmatic minerals. Thus, it is important for an initial ore characterisation effort to be carried out to understand the complete spectrum characteristics of the deposit. An in-depth chemical and mineralogical characterisation of selected samples with a focus on NR-REE geochemistry, mineralogy and associations with clay mineralogy, is very much necessary. The ore characterization study shall include details (non-exhaustive) as listed in **Table 3-3**.

Table 3-3: Information on the ore characterization of the NR-REE deposit

No.	Information	Notes
1.	A suitable characterisation techniques to ascertain NR-REE distribution within varying clay mineralogy.	
2.	To determine the IAC minerals formed through in-situ lateritic weathering of the NR-REE-rich host rocks.	
3.	To study the degree of homogeneity in the samples at microscopic to macroscopic levels.	
4.	To characterise cerium negative or positive anomalies of the deposit profiles.	
5.	To analyse the deposit for the LREE and HREE concentrations which may indicate the mechanisms of ore formation.	

3.2.4 Exploration Methods

A suitable exploration method needs to be used in the exploration of IAC deposits. This is in consideration of various factors related to the thickness of the weathering profile of the deposits, which are regionally variable from as shallow boreholes as a few meters, to depths up to 15 m. Shallow boreholes are the main exploration method for prospecting

of mineral resources in weathered horizon. Drilling depth of this shallow shaft or borehole is generally less than 20 m. The depth of the mechanized version of the drill may reach 30 m, but it is a time-consuming, laborious method with security problems. Basic considerations of exploration methods and equipment used in the exploration works are listed in **Table 3-4**. Typical equipment and machineries used in the ion-adsorption NR-REE exploration are as explained in **Appendix 3-1**.

Table 3-4: Basic considerations on exploration method and equipment

No.	Exploration Method/equipment/factor	Notes
1.	Drill Type – Mechanised, manual	
2.	Maximum depth – 20 m to 30 m, shallow shaft	
3.	Sampling facility – manual	
4.	Efficiency of the equipment	
5.	Mobility of the machinery/equipment	
6,	Security and logistic	
7.	Accessibility of the exploration area	
8.	Environmental sensitivity	
9.	Cost effectiveness	

3.2.5 Mineral Exploration Program

The recommended exploration program should be appropriately planned and can normally be divided into four phases, starting from resource inventory, reconnaissance survey, exploration works, and resource generation. The prospect area should be evaluated at every phase and exploration program shall not move to the next phase if the previous phase returns with negative results. Details on activities to be carried out at each phase of the exploration program are listed in **Table 3-5**.

Table 3-5: Exploration program and phases

No.	Exploration program and phases	Notes
Resource Inventory		
1.	To study previous exploration data and reports.	
2.	Aerial photograph and topography map interpretation of the area.	
Reconnaissance survey		
1.	Regional geological mapping	
2.	Grab sampling	
3.	Channel vertical sampling	
4.	Regional morphology	
Exploration works		
1.	Channel vertical sampling	
2.	Detail geological mapping	
3.	Topographical and geomorphological study	

Table 3-5: Exploration program and phases (Continued)

No.	Exploration program and phases	Notes
4.	Boundary delineation survey	
5.	Geophysical survey	
Resource evaluation		
1.	Borehole design	
2.	Geological model, mineral resource and ore reserves estimation	
3.	Hydrometallurgical analysis	
4.	Mine planning and mining scheme	
Other recommended related features		
1.	To analyse on clay fraction domination of the deposits, whether dominated by kaolinite or halloysite or both, using suitable equipment such as X-ray diffraction (XRD) and infrared spectroscopy.	
2.	To study on the leachability of samples using suitable leaching solution such as ammonium sulphate or magnesium chloride to indicate different profiles of the leachable NR-REE content and to quantify the contents of easily recoverable NR-REE.	
3.	To determine the recovery rates of the leaching process on the deposits.	
4.	To study the hydrology and topography of the deposit location.	
5.	To study the most favourable protoliths of the deposit.	
6.	To study the main primary REE minerals.	
7.	To analyse major and trace elements of the deposit.	

3.2.6 Mineral exploration record management

Comprehensive mineral exploration records from the commissioned exploration program carried out should be properly documented and managed, following best practice guidelines. List of salient areas which need to be appropriately managed are as shown in **Table 3-6**.

Table 3-6: Mineral exploration record management

No.	Salient exploration activities and management	Notes
Data collection		
1.	Geological desk study	
2.	All raw data borehole and trial pit logs	
3.	Location plans	
4.	Testing schedules and test results	
5.	A survey plan showing all borehole, trial pit and sampling locations, and other relevant information	

Table 3-6: Mineral exploration record management (Continued)

No.	Salient exploration activities and management	Notes
6.	General geological setting and stratigraphic sequence.	
7.	Summary schedule of boreholes and trial pits, including records of core recovery, sampling methods, piezometer installation, groundwater and final treatment.	
8.	Structural contour and isopachyte plans and cross sections illustrating the geological and geotechnical interpretation.	
Sampling		
1.	Samples should represent each geological material that will be mined or exposed and each waste type.	
2.	Sampling design to utilise drill holes cross-sections through the deposit.	
3.	The number and type of samples should be site specific and will depend on the phase of project development.	
4.	The number of samples must be sufficient to adequately represent the variability/heterogeneity within each geological unit and waste type.	
5.	Sample collection to consider factors such as grain size, structural defects, alteration, brecciation, veining, etc.	
6.	All samples collected should be properly marked and its location recorded.	
Geophysical survey		
1.	Geophysical survey to give additional information on interpretation layer thickness of the weathering profile correlate with the drilling data.	
2.	Suggested method – Seismic refraction survey and resistivity survey.	
3.	Seismic survey to assist in delineating ore body for IAC body.	
4.	Seismic survey to delineate boundaries for each weathering profile; oxidation zone, moderately weathered zone, slightly weathered zone and fresh rock zone.	
5.	Resistivity survey aids in investigating groundwater such as perched water table aquifer and supports in designing collection tunnel for leaching.	
Boreholes		
1.	Information on material profile depth which include ranges, averages and description on the composition and its variation with depth.	
2.	Borehole logs, schedules and plans describing the material properties relevant to the NR-REE to be produced and estimates of the volumes and percentages of waste materials that will arise from processing.	

Table 3-6: Mineral exploration record management (Continued)

No.	Salient exploration activities and management	Notes
QA/QC sampling		
1.	QA/QC sampling, essential to lending validity to the sampling program and analytical results.	
2.	QA/QC protocol to be based on the industry standard protocol.	
3.	Types of quality control samples relate to the quality assurance of field sampling:	
	✧ Field blanks	
	✧ Split samples or duplicates	
	✧ Standard samples	
4.	The selection of the types of quality control samples should be made prior to the sampling event and included in the site sampling plan.	
Data management storage		
1.	Data storage is to be provided in the exploration project management.	
2.	Data storage to enable access and analyse the data and geostatistics efficiently with an industry standard, audit trail by authorities, investor, etc.	
3.	All original analysis laboratory result by certified chemist must be kept in storage databank.	
4.	Surface sample data – data outline to include:	
	✧ Location	
	✧ Samples type	
	✧ Lithology	
	✧ Results analysis	
5.	Channel and drilling sample data – data outline include:	
	✧ Collar data	
	✧ Survey data	
	✧ Geology data	
	✧ Geotechnical data	
	✧ Assay data	
Safety		
1.	To follow the duties as stipulated in the Mineral Development (Safety in Exploration and Surface Mining) Regulations 2014 especially in the following:	
	✧ Safety management plan – Regulation 3(1) and 3(2)	
	✧ Identification of hazardous areas and others – Regulation 3(3)	
	✧ General duties on safety in a workplace – Regulation 5	

3.3 NR-REE ORE RESOURCE EVALUATION

Resource evaluation is estimated from the results of the mineral explorations. The confidence level of the evaluation will increase (or decrease), depending on the spacing and the number of samples taken. This will directly affect the feasibility study to be made in applying for a mining lease.

3.3.1 Mineral resources

A mineral resource is a concentration or occurrence of material of intrinsic economic interest, in or on the earth's crust in such form, that its quality and quantity are evaluated to be reasonable prospects, for eventual economic extraction. Mineral Resources are further sub-divided, in order of increasing geological confidence, into inferred, indicated and measured categories. Elaboration on the relationship between exploration results, mineral resources and mineral reserves are attached in **Appendix 3-2**.

3.3.2 NR-REE mineral resource estimation

Appropriate terms and abbreviations should be used in reporting resource estimation. **Table 3-7** lists the commonly used terms and abbreviation to avoid any possible confusion.

Table 3-7: Terms and abbreviations on REE resource reporting

No.	Terms / Abbreviation	Definition
1.	RE	Rare Earth
2.	REE	Rare Earth Element
3.	REO	Rare Earth Oxide
4.	REC	Rare Earth Carbonate
5.	RE Resource	To avoid confusion, it is necessary in reporting REE resources to define whether yttrium is included and to report REO values rather than REE
6.	LREE	Light REE, Light Rare Earth Element
7.	LREO	Light REO, Light Rare Earth Oxide
8.	HREE	Heavy REE, Heavy Rare Earth Element
7.	HREO	Heavy REO, Heavy Rare Earth Oxide
8.	LREE	Consisting of La, Ce, Pr, Nd and Sm and the HREE as Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu plus Y. May be extended to include Eu and even Gd
9.	HREE	Consisting of Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu plus Y

Table 3-7: Terms and abbreviations on REE resource reporting (Continued)

No.	Terms/Abbreviation	Definition
10.	SEG and/or middle or medium REE (MREE)	The grouping of Sm, Eu and Gd
11.	Didymium	Nd and Pr
12.	Mischmetal	An alloy of various REE such as Ce, La, Nd and Pr

NR-REE analyses are usually received in reports from the laboratory as parts per million (ppm) for the individual elements. Rare earth oxide (REO) concentrations are then calculated by conversion factors based on the appropriate oxide formulae. NR-REE typically occur in nature in the +3 oxidation number state, with Eu also occurring in the +2 state and Ce in the +4 state. REO pricing is not uniformly based on the +3 state with mixed oxide formulae for Pr (Pr_6O_{11}) and Tb (Tb_4O_7) and the oxidised state of Ce (CeO_2). Many resource statements had mistakenly used a constant conversion based on REE_2O_3.

There are no special issues relating to the mechanics of the estimation of REEs which appear similar in mineralization style to primary and supergene enriched copper deposits. A typical process starts with the estimation of TREO along with LREO and HREO to provide an indication of the ratio of HREO to TREO. By-products with possible value or relevance such as Nb_2O_5, Ta_2O_5, ZrO_2 and P_2O_5 should be estimated but not reported unless there is evidence that they will add value. Although this SOP is all about NR-REE, deleterious (or radioactive) elements such as Th and U, if available, should be still estimated, reported and discussed. Understanding their deportment and distribution should be a priority in any NR-REE mining development.

3.3.3 NR-REE mineral reserves and its reporting

There are differences between mineral reserve and mineral resource. The definition for the relevant terms, used in reporting mineral reserves, are shown **Appendix 3-2**.

Geological reporting rules have evolved according to needs and are more stringent since the 1990s, when the Bre-X scandal kicked off the call for tighter standards for mining companies. Canada's National Instrument 43-101 classification scheme and the Australasian Joint Ore Reserves Committee (JORC) code are two regulatory answers to lax reporting.

However, the codes are very different, and recent cases have highlighted that JORC is driven by the technical needs of the mining business, while NI 43-101 is increasingly becoming a tool for securities regulation. The JORC rules were written by the Joint Ore Reserves Committee, a mining industry body made up of technical professionals. NI 43-

101 was created by the Canadian Securities Administrators, a group that is largely made up of lawyers. NI 43-101 is much more focused on how technical information is shared to the public and specifies what information must go into a press release or technical report.

Resource estimate to illustrate the commercial potential of the area under exploration as far as it is practicable should be based on JORC and NI 43-101 approach. Reported estimate of mineral resource including mineral reserve should contain information as listed in **Table 3-8**.

Table 3-8: Information to be provided in mineral reserve reporting

No.	Information	Notes
1.	Total Rare Earths Oxides (TREO).	
2.	Measured resource tonnage with average grade.	
3.	Indicated resource tonnage with average grade.	
4.	Inferred resource tonnage with average grade.	
5.	The average REO grade.	
6.	Number of samples taken and tested.	
7.	The cut-off grade NR-REE in IAC used in the report.	

MINE PRE-FEASIBILITY STUDY AND FEASIBILITY STUDY

4.0

4.1 INTRODUCTION

In any mining project, the overall mine planning shall commence with a conceptual (or preliminary valuation) study which represents the transformation of a mining project idea into a broad investment proposition. This can be achieved using comparative methods of scope definition and cost estimating techniques to identify a potential investment opportunity. Capital and operating costs are usually approximate ratio estimates using historical data. It is intended primarily to highlight the principal investment aspects of a possible mining proposition. The findings are reported as a preliminary valuation.

In the application of mineral tenements, particularly at the stage of ML or PML application, the conceptual study of the proposed mine is necessary to facilitate and provide inputs in the preparation of a pre-feasibility report as a statutory requirement under Section 63(2), Mineral (Perak) Enactment 2003. Is it part of document to be provided in the application of ML or PML. Upon approval of the ML or PML, as required under Section 64(1)(a) for large scale mining, a feasibility study is required for the proposed mining operation as part of the statutory requirement before the mine shall be permitted to commence its operation.

Notwithstanding of the stipulated coverage of the pre-feasibility study and feasibility study in the Mineral (Perak) Enactment 2003, the said documents shall contain information related to operational and economic aspects of the proposed mining operation. The information shall enable the decision maker to make decision and facilitate the application process.

4.2 STATUTORY REQUIREMENTS

In the application for an ML or PML, it is a requirement for a pre-feasibility study to be prepared, as prescribed in Section 63(2), Mineral (Perak) Enactment 2003. However, as stipulated in Section 64(1)(a) of the enactment, for large scale mining operations, the lessee shall not commence any development work or mining operation on the land, in respect of which the lease has been granted, until after the approval of a mine feasibility

study under Section 73 together with other stipulated conditions. Section 63(2) stipulates that the pre-feasibility study shall include information as disclosed in **Table 4-1**.

Table 4-1: Information in pre-feasibility study as stipulated under section 63(2), Mineral (Perak) Enactment 2003

No.	Information	Notes
1.	General description of the proposed mining scheme.	
2.	The expected commencement date of mineral production (to be stated as the number of months from the date of issuance of the mining lease).	
3.	A schedule of estimated annual raw ore production for the term of the mining lease.	
4.	Such information as may be prescribed.	
5.	Such other information as the state authority may reasonably require for the discharge of its function in relation to the application.	

Section 73(1), Mineral (Perak) Enactment 2003 prescribed that the lessee of a ML or PML authorising a large scale operation shall submit a mine feasibility study for the approval of the State JKSM. If the Committee approves the mine feasibility study, the lessee of the ML or PML authorising a large scale operation shall mine the land in respect of which the mining lease has been granted in accordance with the approved mine feasibility study. Under Section 73(4), the mine feasibility study as required under subsection (1) shall include information as listed in **Table 4-2**.

Table 4-2: Information in feasibility study as stipulated under section 73(4), Mineral (Perak) Enactment 2003

No.	Information	Notes
1.	A mine construction schedule.	
2.	The planned production commencement date.	
3.	A schedule of planned annual raw ore production for the terms of the lease.	
4.	Such other information as may be prescribed or requested by the Committee.	

4.3 MINE PRE-FEASIBILITY REPORT

Preliminary or pre-feasibility study is an intermediate level exercise, normally not suitable for an investment decision (as opposed to the actual and thorough feasibility study). It has the objectives of determining whether the project concept justifies a detailed analysis by a feasibility study, and whether any aspects of the project are critical to its viability. It necessitates in-depth investigation through functional or support studies. A preliminary

study should be viewed as an intermediate stage between a relatively inexpensive conceptual study, and a relatively expensive feasibility study. The important sections of a pre-feasibility report are as shown in **Table 4-3** with the details in **Table 4-4**.

Table 4-3: Main sections of a mine pre-feasibility study report

No.	Information	Notes
1.	Objectives	
2.	Technical concept	
3.	Findings	
4.	NR-REE reserve and grade	
5	ISL mining and production schedule	
6.	Capital cost estimate	
7.	Operating cost estimate	
8.	Revenue estimate	
9.	Taxes and financing	
10.	Cash flow	

Table 4-4: Content of a mine pre-feasibility study report

No.	Information	Notes
Objectives		
1.	States briefly the objective of the ML/PML application.	
2.	Sources of information shall be listed.	
Technical concept		
1.	Describes very briefly where the ML/PML is located.	
2.	Proposed or assumed activities to be carried out in the course of production.	
3.	How the proposal may be achieved, and what is to be done with the products.	
Findings		
1.	A summary, preferably in sequential and mainly tabular forms, of the important figures and observations from all the remaining sections.	
2.	This section may equally be termed as conclusions.	
NR-REE reserve and grade		
1.	Brief notes on geology and structure, if applicable.	
2.	Information on the drilling and sampling accomplished.	
3.	Tonnages and grades, both geological and minable and possibly at various cut-off grades, are given in tabular form with an accompanying statement on their status and reliability.	
ISL mining and production schedule		
1.	Tabulates the mining program (including preproduction work), the processing program, any expansions or capacity changes, the recoveries and product qualities and outputs of products.	

Table 4-4: Content of a mine pre-feasibility study report (Continued)

No.	Information	Notes
Capital cost estimates		
1.	Tabulates the cost to bring the ML/PML to production from the time of approval.	
2.	The cost to include costs of further exploration, research and studies.	
3.	Any pre-report costs, being sunk, may be noted separately.	
4.	An estimate of post-production capital expenditures.	
Operating cost estimates		
1.	Tabulates the cash costs of mining, processing, other treatment, ancillary services, administration, etc.	
2.	Depreciation	
s	Post-mine treatment and realization costs	
Revenue estimate		
1.	Records the product prices used, states the realization terms and costs, and calculates the net price at the deemed point of disposal.	
Financing and tax data		
1.	State what financing assumptions have been made, all equity, all debt or some specified mixture, together with the interest and repayment terms of loans.	
2.	A statement on the tax regime specifies tax holidays (if any), depreciation and tax rates, (actual or assumed) and any special features.	
Cash flow		
1.	Present year-by-year projections of cash movements in and out of the project.	
2.	Depending on company practice and instructions, investment indicators such as internal rate of return, debt payback time, or cash flow after payback may be displayed.	
Notes		
1.	Any cautions or reservations the report cares to make should be incorporated in one of the first three (3) sections.	
2.	The general aim is that the non-technical or less-technical reader should be adequately informed about the ML/PML application by the time one has read the end of findings.	

4.4 MINE FEASIBILITY REPORT

The feasibility study (actual and thorough) provides a definitive technical, environmental and commercial basis for an investment decision. It uses iterative processes to optimize all critical elements of the project. It identifies the production capacity, technology, investment and production costs, sales revenues, and return on investment. Normally it

defines the scope of work unequivocally, and serves as a base-line document for advancement of the project through subsequent phases. Due to the importance of this report, it is necessary to include all detailed information that supports a general understanding and appraisal of the project, or the reasons for selecting necessary or particular processes, equipment or courses of action. The two important requirements for the feasibility reports are that it must be easy to read, and their information must be easily accessible and understood by non-technical individuals.

The essential functions of the feasibility report are listed in **Table 4-5** with the details of the content elaborated in **Table 4-6**.

Table 4-5: Essential functions of the feasibility report

No.	Salient exploration activities and management	Notes
1.	To provide a comprehensive framework of established and detailed facts concerning the mining project.	
2.	To present an appropriate scheme of exploitation with designs and equipment lists taken to a degree of detail sufficient for accurate prediction of costs and results.	
3.	To indicate to the project proponent and other stakeholders the likely profitability of investment in the project if equipped and operated as the report specifies.	
4.	To provide this information in a form intelligible to the project proponent and suitable for presentation to prospective partners or to sources of finance.	

Table 4-6: Content of a mine feasibility study report

No.	Information	Notes
General		
1.	Topography, climate, population, access and services.	
2.	Suitable sites for processing plant, mine infrastructure and amenities.	
Geological (Field)		
1.	Geological study of structure, ore mineralization and possibly of genesis.	
2.	Sampling by drilling or other methods.	
3.	Bulk sampling for checking and for metallurgical testing.	
4.	Extent of leached or oxidized areas.	
5.	Assaying and recording of data, including quality control and assurance, materials properties, strength and stability.	
6.	Closer drilling of areas scheduled for the start of mining.	
7.	Geophysics and indication of the likely ultimate limits of mineralization.	
8.	Sources of water supply and construction materials.	

Table 4-6: Content of a mine feasibility study report (Continued)

No.	Information	Notes
Geological and mining (Office)		
1.	Checking, correcting and coding of data for computer input.	
2.	Calculations of ore tonnages and grades.	
3.	Assay compositing and statistical analysis.	
4.	Estimation of mineral resources and mineable reserve, segregated as needed by ore body, by ore type, and by grade categories.	
5.	Derivation of the economic parameters used in the determination of minable reserves.	
Mining		
1.	ISL mine layouts and plans.	
2.	Determination of pre-production mining or development requirements.	
3.	Estimation of ore dilution and ore losses.	
4.	Production schedules, in detail for the first few years but averaged thereafter	
5.	Labour and equipment requirements and cost, and an appropriate replacement schedule for the major equipment.	
Hydrometallurgical process (Research)		
1.	Bench testing of representative drilling samples.	
2.	Selection of the extraction process.	
3.	Small scale pilot plant testing of composite or bulk samples followed by larger scale pilot plant operation over a period of months should this work appear necessary.	
4.	Specification of the processing, nature and quality of products.	
5.	Details of the product samples.	
6.	Estimating the effects of ore type or head grade variations upon recovery and product quality.	
Hydrometallurgical process (Design)		
1.	The detailed treatment concept with flowsheets, mass balance and calculation of flux.	
2.	Specification of recovery and of product grade.	
3.	General siting and layout of plant with drawings.	
Ancillary services and requirements		
1.	Access, transport, power, water, fuel and communications.	
2.	Workshops, offices, change-houses, laboratories, sundry buildings and equipment.	
3.	Labour structure and strength.	
4.	Housing and transport of employees.	
5.	Other matters related to social requirements.	
Capital cost estimation		
1.	Develop the mine and plant concepts and make all necessary drawings.	

Table 4-6: Content of a mine feasibility study report (Continued)

No.	Information	Notes
2.	Calculate or estimate the equipment list and all important quantities (of excavation, concrete, building area and volume, pipework, etc.).	
3.	Determine a provisional construction schedule.	
4.	Obtain quotes of the direct cost of items of machinery, establish the costs of materials and services, and of labour and installation.	
5.	Determine the various and indirect costs, which include freight and taxes on equipment, contractors' camps and overheads plus equipment rental, labour punitive and fringe costs, the owner's site office, supervision and travel, purchasing and design costs, licenses, fees, customs duties and sales taxes.	
6.	Warehouse inventories.	
7.	Contingency allowances.	
8.	Operating capital sufficient to pay for running the mine until the first revenue is received.	
9.	Financing costs and, if applicable, pre-production interest on borrowed money.	
Operating cost estimation		
1.	Define the labour strength, basic pay rates, and fringe costs.	
2.	Establish the quantities of important measurable supplies to be consumed – power, fuel, chemicals, reagents, etc. – and their unit costs.	
3.	Determine the hourly operating and maintenance costs for mobile equipment plus fair performance factors.	
4.	Estimate the fixed administration costs and other overheads plus the irrecoverable elements of social costs.	
Marketing		
1.	Product specifications, transport, marketing regulations or restrictions.	
2.	Market analysis and forecast of future prices.	
3.	Likely purchasers.	
4.	Costs of freight, further treatment and sales.	
5.	Draft sales terms, preferably with a letter of intent.	
6.	Merits of direct purchase as against toll treatment.	
7.	Contract duration, provisions for amendment or cost escalation.	
8.	Requirements for sampling, assaying and umpiring.	
9.	The existence of a market contract is usually an important pre-requisite to the loan financing of a new mine.	
Rights, ownership and legal matters		
1.	Mineral rights and tenure.	
2.	Rents and royalties.	
3.	ML/PML acquisitions or securement by option or otherwise.	

Table 4-6: Content of a mine feasibility study report (Continued)

No.	Information	Notes
4.	Surface rights to land, water, rights-of-way, etc.	
5.	Licenses and permits for construction as well as operation.	
6.	Employment laws for local and expatriate employees separately if applicable.	
7.	Agreements between partners in the enterprise.	
8.	Legal features of tax, currency exchange and financial matters.	
9.	Company incorporation.	
Financial and tax matters		
1.	Suggested organization of the enterprise, as corporation, joint-venture or partnership.	
2.	Financing and obligations, particularly relating to interest and repayment of debt.	
3.	Foreign exchange and reconversion rights, if applicable.	
4.	Study of tax authorities and regimes, whether single or multiple.	
5.	Depreciation allowances and tax rates.	
6.	Tax concessions and the negotiating procedure for them.	
7.	Appropriation and division of distributable profits.	
Environmental effects		
1.	Environmental study and report; the need for pollution control and waste management, mitigating potential geohazards during development and operation.	
2.	Prescribed reports to government authorities, plans for restoration of the area after mining ceases.	
Social impacts		
1.	Positive and negative impacts of the project to the local community and way forward to mitigate all pertinent issues.	
2.	Managing community responses and regulatory compliances.	
3.	Local community and stakeholders engagement	
Revenue and profit analysis		
1.	The mine and production schedules and the year-by-year output of products.	
2.	Net revenue at the mine (at various product prices if desired) after deduction of transport, treatment and other realization charges.	
3.	Calculation of annual costs from the production schedules and from unit operating costs derived previously.	
4.	Calculation of complete cash flow schedules with depreciation, taxes, etc. for some appropriate number of years – individually for at least ten (10) years.	
5.	Presentation of totals and summaries of results.	
6.	Derived figures (rate of return, payback, profit split, etc.) as specified by owner or client.	

Table 4-6: Content of a mine feasibility study report (Continued)

No.	Information	Notes
7.	Assessment of sensitivity to price changes and generally to variation in important input elements.	

OPERATIONAL MINING SCHEME

5.0

5.1 INTRODUCTION

Operational Mining Scheme (OMS) is a technical document for a particular mining operation which need to be prepared and approved before the commencement of any activity within the mining area. It is a legal document which details the layout setting, in the case of NR-REE mining of IAC deposit: the ISL working platform, hydrometallurgical plant, the piping system network, and other mine infrastructure and amenities.

To achieve operational efficiency, a mine design shall need to be completed, as incomplete mine design may lead to unacceptable environmental impacts, nuisance, or dangers to the public and workforce, resulting in additional monitoring costs for the operator and the authorities. Therefore, good mine design is an essential step towards sustainable OMS.

With guidance principle of sustainable mining, it is mandatory for the mining operation to be designed and planned not only based on geological, economical and technical factors, but also in accordance with sustainable development principles. It is during planning that the most important decisions regarding work environment and safety are made when deciding on mining methods, technology, work organisation, and so on.

5.2 STATUTORY REQUIREMENTS

An OMS is a legal document as stipulated under Section 10(1), Mineral Development Act 1994, which prescribed that an OMS must be submitted and approved by the Director of Mines before any mine could be allowed to operate, resume or reorganise its operation. The OMS needs to be prepared according to the provisions of the Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007. JMG has also produced guide documents for the preparation of the OMS, Guidelines on the Preparation of OMS (JMG 2019) (**Appendix 5-3**) and Circulars of JMG Director General – Circular No. 1/2018, dated 5 March 2018 and Circular No. 1/2020, dated 1 July 2020 (**Appendix 5-4).**

Other statutory requirements which shall be complied in the design of an OMS are the Environmental Quality Act 1974 and various relevant regulations and guidelines relevant to the project development and operation as shown in **Table 5-1**.

Table 5-1: Main referred laws, regulations and documents in the preparation of OMS

Statutory requirements	Document / Report for approvals	Regulations / Guidelines
Section 10(1), Mineral Development Act 1994	Operational Mining Scheme (OMS)	✧ Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 ✧ Guidelines on the Preparation of OMS (JMG 2019) ✧ Circular of JMG Director General – Circular No. 1/2018, Dated 5 Mar 2018 and Circular No. 1/2020, dated 1 July 2020
Section 14(11), Mineral Development Act 1994	Mine Safety Management	✧ Mineral Development (Safety in Exploration and Surface Mining) Regulations 2014 ✧ Various Laws and Regulations under the OSHA 1994 and FMA 1967
Section 34(A), Environmental Quality Act 1974	Environmental Impact Assessment (EIA)	✧ EIA Order 2015 ✧ EIA Guidelines in Malaysia (EGIM) (JAS 2016) ✧ EIA Guidelines for Quarry and Mining (JAS 2018)
	Environmental Management Plan (EMP)	✧ EIA Guidelines in Malaysia (EGIM) (JAS 2016) ✧ EIA Conditions of Approval (COAs)
	Erosion and Sediment Control Plan (ESCP)	✧ MSMA (Second Edition) (JPS 2012) ✧ Guidelines for Erosion and Sediment Control in Malaysia (JPS 2010). ✧ EIA COAs
	Land Disturbing, Pollution Prevention and Mitigation Measures (LDP2M2)	✧ Guidance document for the Preparation of the Document on LDP2M2 as per Appendix 4 of the EGIM (JAS 2016).

5.3 MINE DESIGN AND OPERATIONAL MINING SCHEME

Mine design is an inclusive and iterative process undertaken by a team of people covering a wide range of technical and commercial disciplines. Successful mine designs involved or take into account of the views and requirements of all relevant interested and affected parties. The primary objectives of good mine design are the safe, efficient, and profitable

extraction of the maximum usable material from the minimum area of land while causing the minimum environmental disturbance and resulting in beneficial final restoration and land-use.

A proposed mining operation shall operate within a stringent and manageable environment care, as provided by the laws and good practices, throughout its operational life and after its closure. An OMS seeks to deliver effective environmental management and compliance at operational stage, closure and post closure through appropriate final rehabilitation. This can be achieved through a competent mine design that includes environmental inputs as an integral activity and delivers compliance with appropriate regulations, legislation and best practices. An example of a NR-REE IAC ISL mine layout in China, similar as that being planned in Malaysia can be viewed in Google Earth at coordinates; N22^0 49' 18.5", E110^0 00' 21.3".

On safety and operational efficiency, a mine design must be capable of being practically implemented, with inherently safe and secure operations and structures including after the completion of the mining operation. This may be achieved through design that delivers compliance with appropriate regulations and best practices and is based on adequate reliable information and analysis. An OMS as stipulated in Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 shall consist of information as listed in **Table 5-2**.

Table 5-2: Essential information on OMS report as prescribed under Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007

No.	Essential information on OMS report	Notes
Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 (Derived)		
1.	Surface rights ownership of the mine area with all leases, deeds and agreements with surface rights owners.	
2.	Description of the site including all significant surface features, with an assessment of ground stability of the workings of the mine, together on detailed location of the proposed mine workings.	
3.	Various categories of the mine reserve; mineable ore reserves including measured, possible or inferred ore reserves.	
4.	Proposed ISL mining methods, schedules for all development work and mining equipment to be used.	
5.	All category and number of workers required during each phase of development works and production.	
6.	Methods and procedures for removal of mineral ore and wastes shall be elaborated.	

Table 5-2: Essential information on OMS report as prescribed under Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 (Continued)

No.	Essential information on OMS report	Notes
7.	Mineral processing to be undertaken, including equipment and hazardous material to be used.	
8.	Mining and mineral processing – Waste management and disposal.	
9.	Hazardous materials handling including transportation, usage and storage shall be described.	
10.	Mine products handling and transportation shall be detailed.	
11.	Storage of tailings, topsoil, overburden, mineral ore and wastes shall be detailed.	
12.	Environmental protection including pollution control, monitoring, contingency plans, and geohazard mitigation measures.	
13.	Safety procedures during development work.	
14.	Proposed progressive rehabilitation and post mine closure plans.	
Other information		
1.	Managing community responses and regulatory compliances.	
2.	Identification of 'red-button' mechanism (critical total stop) and other monitoring and feedback-response facility.	

It needs to be emphasized that the OMS plan is an important component of the overall mining scheme (of the proposed operation), as described in Regulation 4(1), Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007. This regulation stipulates that accurate plans of the workings of the mine consisting of details as listed in **Table 5-3** shall be maintained by a Mine Manager of the operation.

Table 5-3: Details of accurate plans of the workings mine

No.	Accurate plans, records and information	Notes
Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 (Derived)		
1.	Actual engineering survey of the mine.	
2.	Surface layout.	
3.	Separate drawings on the horizontal plane for each level showing where relevant all sub-surface mine structures and systems.	
4.	Separate drawings on the vertical plane of all mine sections at suitable intervals and azimuths, showing where relevant mine structures and systems and other mine workings in relation to the surface, including the location of any known watercourse or body of water.	

Table 5-3: Details of accurate plans of the workings mine (Continued)

No.	Accurate plans, records and information	Notes
Other information		
1.	Records of subsurface information on the occurrence of the NR-REE deposit.	
2.	Geological information of the mine area.	
3.	Records of all information pertaining to the mining operation and inspection journals.	
4.	Records of monitoring details; surface and groundwater, performance and compliance to environmental monitoring.	

5.4 PREPARATION OF OPERATIONAL MINING SCHEME REPORT

The OMS report shall be prepared for submission to JMG for approval. The report covers information, specific studies and documents to support both the legal and technical requirements of the approval process.

5.4.1 Basic information and particulars

Information and certified copies of the following documents need to be made available to the appointed Consulting Mining Engineer for the preparation and submission of an OMS to JMG. The documents are as listed in **Table 5-4**.

Table 5-4: Basic information and particulars for the OMS Report

No.	Information and particulars	Notes
Documents		
1.	Title – ML/PML	
2.	Other title (If any) – additional land for specific purpose	
3.	Organisational chart	
4.	Company Registration Documents – Form 24, Form 49, Memorandum and Article of Association or all relevant documents under the Companies Act 2016	
5.	Agreements if any between ML/PML holder and the Mine Operator/Contractor	
Particulars of operator		
1.	The Applicant	
2.	Address of the Applicant	
3.	Contact Person	
4.	Tel. No., Fax no., E-Mail	
Particulars of the mineral tenements		
1.	Lot No.	
2.	ML/PML No.	

Table 5-4: Basic information and particulars for the OMS report (Continued)

No.	Information and particulars	Notes
3.	ML/PML Holder	
4.	Area (Ha)	
5.	Mukim	
6.	District	
7.	Date of Issuance	
8.	Date of Expiry	
9.	Standard Sheet No.	
10.	Topographical Map No.	
11.	File Reference	
Particulars of consulting mining engineer		
1.	Name	
2.	Qualifications	
3.	Professional Affiliations	
4.	Consulting Firm	
5.	Address	
6.	Tel. No., Hand phone No., Fax No., E-mail	
Particulars of consulting geologist		
1.	Name	
2.	Qualifications	
3.	Professional Affiliations	
4.	Consulting Firm	
5.	Address	
6.	Tel. No., Hand phone No., Fax No., E-mail	

5.4.2 Technical information and studies in the OMS report

Technical information of the mine project with relevant reports are needed in the preparation of OMS, and they are listed in **Table 5-5** while Table 5-6 lists the safety requirement in the mine design.

Table 5-5: Technical information and particulars for the OMS report

No.	Information and particulars	Notes
Site physical environment		
1.	Details on the mine location including plans prepared on suitable scale as prescribed in the OMS Guidelines.	
2.	Coordinates – MRSO/WGS 84/GDM 2000.	
3.	Geomorphology – includes topography, drainage system etc.	
4.	Existing sensitive structure on site and adjoining terrain.	
5.	Adjoining interest and surrounding land use.	
Mine reserve		
1.	NR-REE Reserve	
2.	Production	

Table 5-5: Technical information and particulars for the OMS report (Continued)

No.	Information and particulars	Notes
3.	Mine life	
Site geological information		
1.	Hydrological and hydrogeological data	
2.	Structural geology	
3.	Geohazard assessment	
Mine design and planning		
1.	Project concept and design	
2.	Geological and structural characteristics of the deposit	
3.	ISL Platform	
4.	Tanks and chemical storage facilities	
5.	Piping system network	
6.	Erosion and sediment control BMPs	
7.	Mine office, laboratory, quarters	
8.	Riparian and buffer zone	
Hydrometallurgical plant		
1.	Description of the REC processing	
2.	Plant structures and equipment	
Product storage facility		
1.	Description on storage facility	
2.	Product transportation	
Erosion and sediment control		
1.	ESCP	
2.	LDP2M2	
3.	BMPs	
Environmental Management Plan (EMP)		
1.	Environmental monitoring	
2.	Groundwater monitoring	
3.	Slope monitoring	
4.	Radioactivity monitoring	
5.	Environmental auditing – compliance and performance	
6.	Compliance with all EIA COAs	
Safety management		
1.	Mine Safety Management Plan	
2.	Emergency Response Plan (ERP)	
3.	Machinery and equipment registration under FMA	
4.	Journal/record book on the mine inspection	
Manpower requirement		
1.	Category of workers and numbers	
2.	Status of local or foreign workers and their numbers	
3.	Status of contractors or operators employed	
Mine amenities		
1.	Electricity	

Table 5-5: Technical information and particulars for the OMS report (Continued)

No.	Information and particulars	Notes
2.	Water	
3.	Workers accommodation	
4.	Communications	
Mine rehabilitation plan		
1.	Progressive rehabilitation plan	
2.	Mine closure plan	

Table 5-6: Safety in the mine design

No.	Safety in the mine design	Notes
Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 (Derived)		
1.	The mine design shall take into consideration the health and safety risks of extracting the minerals.	
2.	The design shall detailed the set out of the ISL platforms and the metallurgical plant, the type of equipment to be installed, the access road alignment, and the control measures necessary to ensure aspects of health, safety and environment impacts.	
3.	Geotechnical and geohazards features of the site have to be taken into consideration in the mine design. These shall determine how the deposit will be worked upon safely.	
4.	The mine shall be designed with the extraction limits, defined by the geomorphology of the mine area.	

5.5 SITE HYDROLOGY

Site hydrological data shall include surface water divisions and their associated catchments and sub-catchments, as well as water levels and flow in rivers, lakes and streams. Mining operations can influence both the quantity and quality of water as mines are significant water users and producers of wastewater. This section shall describe the existing hydrological domain required and the impacts anticipated to arise from the implementation of the proposed project.

The activities under this requirement are aimed to assist, evaluate and construct the actual river water situation based on the existing conditions prior to any commencement of the development and mining phases. In order to evaluate the mining activities that may affect the river water in the area, detail activities and data collection necessary for the hydrological study of the mine area are listed in **Tables 5-7,** while the parameters required in the hydrology baseline study are listed in **Table 5-8**. The hydrological analysis of surface water required to envisage the impact and change to the surface water system are shown in **Table 5-9**.

Table 5-7: Information required in the hydrological study

No.	Information	Notes
Topography – To describe the topographical features		
1.	Data – Topographical map and Digital Elevation Model (DEM).	
2.	Analysis – Elevations, slopes, sub-basins and flow directions.	
Morphology – To estimate the natural characteristics of the drainage basin		
1.	Data – Land-use map, surface water and surface water catchment.	
2.	Analysis – Physical characteristics of the drainage basins, including lengths, areas and slopes.	
Geology – To determine and classify the types of soil and rocks, and distribution of faults and fractures/lineaments.		
1.	Data – Geological map and field data	
2.	Analysis – Types, distribution and thickness of soils and rock, pattern and alignment of faults and fractures/lineaments.	
Meteorology – To determine the rainfall amount that may affect the runoff volumes for each drainage basin of the area		
1.	Data – meteorological data	
2.	Analysis – Rainfall design storm characteristics, hydrological calculations, estimated rainfall, storm durations, hydrograph representations and storm distributions.	
Hydrology – To conclude on the hydrographs of the drainage basin of the area and calculation of the maximum flow and expected volume of the water		
1.	Data – Meteorological and hydrological, discharge and stream flow.	
2.	Analysis – Volume of water, the disposal and maximum time for the arrival of peak times.	

Table 5-8: Activities and parameters required in the hydrology baseline study

No.	Activities/Parameters	Notes
River cross section survey		
1.	Width and depth of main rivers and tributaries.	
2.	Upstream and downstream conditions.	
Potable water source survey		
1.	Number of intake point.	
2.	Location.	
3.	Status of usage.	
River water data collection and sampling		
1.	Streamflow data, long-term mean annual flow and lowest flow event.	
2.	Temperature, DO, turbidity, pH, BOD, COD, Ammoniacal Nitrogen, TSS, SO_4, oil and grease, Faecal Coliform and Total Coliform.	
3.	Heavy metals.	

Table 5-8: Activities and parameters required in the hydrology baseline study (Continued)

No.	Activities/Parameters	Notes
River Quality Monitoring Data (JAS)		
1.	Temperature, DO, pH, BOD, COD, Ammoniacal Nitrogen, TSS, SO_4, NO_2, NO_3, Fe, Mn, Cu, Zn, Al, As, Pb, Cd and Ni.	

Note: Number and locations of survey/sampling/test should represent each mining lease area.

Table 5-9: Surface water hydrology analysis based on the preliminary assessments

No.	Subject/Analysis	Notes
River hydrological analysis		
1.	Simulation on normal flow, low flow and storm water flow on main rivers/catchments.	
2.	Two (2) different scenarios of storm water flow, short term (months) and long term (years).	
Hydraulic modelling using any suitable software		
1.	Derivation on flow and water level hydrographs.	
2.	Establishment of river networks, river cross sections, boundary condition data and hydrodynamic parameters.	
3.	Calibration on model analysis with the recorded water level records.	
Water quality modelling using any suitable software		
1.	Simulation on the chemical and physical processes, and the interactions with ecosystem state variables.	
2.	Simulation on four (4) different scenarios, baseline, during operation, Wastewater Treatment Plant (WWTP) failure and pipeline leak.	
3.	Calibration on model analysis with the recorded water quality data.	
Water quality impact assessment		
1.	Evaluation on the impact to water quality, against national standard of National Water Quality Standards (NWQS) and MOH Raw Water Quality Standards (RWQS).	
2.	Simulation on four (4) different scenarios, baseline, during operation, Wastewater Treatment Plant (WWPT) failure and risk of Acid Mine Drainage (AMD).	

5.6 SITE HYDROGEOLOGY

Hydrogeology is the study of the movement of water through the subsurface geologic environment. The groundwater within and in the vicinity of the proposed operation shall be affected if appropriate mitigation measures are not implemented. Detailed hydrogeological survey within and around the mining lease is necessary. Data collection

and detailed fieldworks necessary for the hydrogeological study of the mine area are listed in **Table 5-10** and **Table 5-11.**

Table 5-10: Information required in the hydrogeological study

No.	Information	Notes
Topography		
1.	Data – Topographic maps, Digital Elevation Model (DEM), surface water and surface water catchment.	
2.	Analysis – Elevations, slopes and flow directions.	
Hydrogeology		
1.	Data – Hydrogeological units, basic geochemistry, permeability, transmissivity, storativity, well inventory, groundwater time series and local uses of groundwater.	
2.	Analysis – Properties of aquifers, aquitards and aquicludes, groundwater flux. and construction of conceptual model	
Geology		
1.	Data – Geological map, tectonic, stratigraphic descriptions and geophysical data.	
2.	Analysis – Types, distribution and thickness of soils and rock, pattern and alignment of faults and fractures/lineaments.	
Meteorology		
1.	Data – Meteorological data.	
2.	Analysis – Recharge calculation	
Hydrology		
1.	Data – Stream and stream flow	
2.	Analysis – Interaction between groundwater and surface water.	
Pollution sources		
1.	Data – Inventory of non-point sources and point sources, map of flood prone areas.	
2.	Analysis – Non-point sources and point sources, identify/specify location and concentration of the potential sources.	

Table 5-11: Activities and parameters required in the groundwater baseline study

No.	Information	Notes
Borehole drilling		
1.	Lithology and stratigraphy of soils and rock.	
2.	Thickness of soil.	
3.	Depth of bedrock.	
4.	Groundwater level.	
Groundwater sampling		
1.	All standard parameters of groundwater quality analysis, based on the Conventional Raw Water Treatment (Drinking Water) of Malaysia Groundwater Standard and Index (MSGI), (JAS 2019)	

Table 5-11: Activities and parameters required in the groundwater baseline study (Continued)

No.	Information	Notes
Pumping and recovery test		
1.	Hydraulic conductivity, *K. T & S*	
2.	Porosity	
3.	Discharge rate and time-drawdown	
Geophysical surveys		
1.	Thickness of weathering grade/zone/bedrock	
2.	Fault/lineament zones	
3.	Groundwater level and for recharge and discharges points/zones	

The activities under this stage is aimed to assist, evaluate and construct the actual groundwater situation based on the existing conditions prior to any commencement of the development and mining phases. The study shall be performed within and around the mining lease. One of the essential activities is the identification of existing tubewells and planning for new borehole drillings. A guideline for groundwater sampling is referred to Garis Panduan Pengukuran Paras Air Tanah dan Persampelan, JMG.GP.16 (JMG 2020). Detailed information on the application of parameters obtained are listed in **Table 5-12.**

Table 5-12: Groundwater system analysis based on preliminary assessments

No.	Information	Notes
Hydrogeological framework		
1.	Contour map to show the extent and thickness of aquifers and fractures/lineaments in bedrock.	
2.	Cross-sections, minimum two (2) that perpendicular to each other, showing the aquifers, aquitards and aquiclude.	
3.	Table and map showing layers of aquifers, aquitards, lithology and estimated values of hydraulic parameters.	
Groundwater flow		
1.	Contour map of interpolated groundwater table.	
2.	Map on the estimation on the water balance, zones and volume of recharge and discharge.	
3.	Cross-sections of groundwater flow lines showing size and depth of major groundwater flow systems within mining lease and vicinity areas.	
Conceptual model		
1.	3D model on the geological framework and groundwater flow.	
2.	Identification of aquifers, aquitards and aquicludes, represented by their *K* values.	
3.	Infiltration rates, recharge and discharge zones, and other boundary conditions.	

Table 5-12: Groundwater system analysis based on preliminary assessments (Continued)

No.	Information	Notes
Assessment of groundwater quality		
1.	Aquifer systems – map of selected areas/points with the locations of sampling wells, and tables/graphs on the water quality of each well. Temporal and spatial groundwater quality data.	
Groundwater modelling (Using suitable software)		
1.	Construction/set-up of groundwater model – discretization, boundary conditions and fluxes, initial conditions and stresses.	
2.	Groundwater flow modelling – simulation of groundwater flow	
3.	Model calibration with observed data – groundwater level, exchange rates between surface water and groundwater and discharge from pumping wells.	
4.	Validation and sensitivity analysis	
5.	Contaminant transport modelling – simulation of contaminant migration. Simulation on assumptions worst case scenario of leaching solution leaking into the bedrock/groundwater system.	
6.	Pathline analysis, travel-time range from 1-day to 30-years. Prediction shall be done and reported for 1-day, 10-years and 30-years.	

5.7 SITE GEOTECHNICAL STUDY AND MONITORING

During ISL, occurrences such as injection hole collapsing, or leakage of the leachate, may happen during the leaching process. Such instances may cause slope/mass movement or landslides and may be a precursor to other environmental damages. To reduce the probability of such mishaps, basic slope safety monitoring and examination as listed in **Table 5-13** shall be implemented. A baseline geotechnical study of the ISL platform as presented in **Table 5-14** shall also be carried out.

Table 5-13: Slope safety monitoring and examination

No.	Slope monitoring systems	Notes
Surface measurements – Relative displacement measurement		
1.	**Imaging techniques/UAV mapping** ✧ Visual inspection method to monitor along the perimeter of mining area. ✧ Regular flying to assess changes on the slope.	
2.	**Rain gauge** ✧ Rainfall monitoring.	

Table 5-13: Slope safety monitoring and examination (Continued)

No.	Slope monitoring systems	Notes
3.	**Crackmeter** ✧ Measurement on the movement of tension cracks at the crest of the slope. ✧ Monitoring of length, widths and vertical offsets of cracks that appear at the crest of slope or elsewhere.	
Sub-surface measurements		
1.	**Piezometers** ✧ Measurement on pore-water pressures and ground water levels, and in evaluating the effects of seasonal variations.	
2.	**In-place inclinometers** ✧ Continuous subsurface lateral movements monitoring. ✧ Detection on new movement, an acceleration of movement, and the direction of movement.	

Table 5-14: Activities and parameters required in the baseline study

No.	Activities/Parameters	Notes
Borehole drilling		
1.	Lithology and stratigraphy of soils and rock.	
2.	Strength of soils (SPT-N) and rock (RQD, TCR, SCR)	
3.	Thickness of soil and/or depth of bedrock.	
4.	Groundwater level.	
Soil sampling		
1.	Moisture content.	
2.	Unit weight and specific gravity.	
3.	Atterberg limits.	
4.	Particle size distribution.	
Geophysical surveys		
1.	Thickness of weathering grade/zone/bedrock	
2.	Fault/lineament zones	

5.8 ESTIMATED NR-REE RESERVE

Mine reserve estimation of NR-REE has been elaborated In **Chapter 3, Section 3.3** of the SOP. For the preparation of OMS, detailed information as shown in **Table 5-15** are required. Information pertaining to the components of the RE elements and their proportions, as listed in **Table 5-16,** shall also need to be provided.

Table 5-15: Technical information on NR-REE reserve for the OMS report

No.	Information and particulars	Notes
1.	ML/PL	
1.	ML/PL	
2.	Mukim	
3.	Land Proprietor	
4.	Land Category	
5.	Date of expiry	
6.	Area	
	✧ ISL platform	
	✧ Metallurgical plant	
	✧ Piping, access and BMPs	
	✧ Riparian and buffer zone	
7.	Elevation of mine surface	
8.	Depth of deposit	
9.	Thickness of deposit	
10.	Ore grade	
11.	Number of exploration drill holes	
12.	Number of samples analysed	
13.	Exploration drill holes length	
14.	Reserve	
	✧ TREO (MT)	
	✧ REC (MT)	
	✧ REC (RF - 70%) (MT)	
15.	Average Production (TPM)	
16.	Mining life (Month)	
17.	Revenue (RM) (Estimated Gross)	

Table 5-16: Components of the RE oxides and their proportions

No.	Information and particulars			Notes
	RE Oxides	ppm	%	
1.	Lanthanum oxide (La_2O_3)			
2.	Cerium oxide (CeO_2)			
3.	Praseodymium oxide(Pr_6O_{11})			
4.	Neodymium oxide (Nd_2O_3)			
5.	Samarium oxide (Sm_2O_3)			
6.	Europium oxide (Eu_2O_3)			
7.	Gadolinium oxide (Gd_2O_3)			
8.	Terbium oxide (Tb_4O_7)			
9.	Dysprosium oxide (Dy_2O_3)			
10.	Holmium oxide (Ho_2O_3)			
11.	Erbium oxide (Er_2O_3)			
13.	Promethium oxide (Pm_2O_3)			

Table 5-16: Components of the RE oxides and their proportions

No.	Information and particulars			Notes
	RE Oxides	ppm	%	
14.	Thulium oxide (Tm_2O_3)			
15.	Ytterbium oxide (Yb_2O_3)			
16.	Lutetium oxide (Lu_2O_3)			
17	Ytrium oxide (Y_2O_3)			

5.9 ISL IAC MINING OPERATION

Description of the proposed ISL IAC mining need to be elaborated in the OMS Report. Information required and particulars needed are as shown in **Table 5-17** with the land utilisation and proportions shown in **Table 5-18**. Technical background of the ISL IAC mining is presented in **Appendix 5-1**.

Table 5-17: Technical information on ISL IAC mining operation

No.	Information and particulars	Notes
1.	Geological formation of the IAC within the project area.	
2.	Leaching mechanism – Mechanism on how the leaching solution exchange and leach the adsorbed RE ions from heterogeneous ore bodies.	
3.	Leaching process – Detail technical description of the leaching process, to include the process flowchart and estimation on the quantity and dose of the leaching solution to be used.	
4.	Thei borehole – Specifications and arrangement of the injection boreholes, including diameter, spacing and piping.	
5.	ISL fluid management – Description of the ISL fluid management with respect to various relevant structures. The pregnant solution which contains rare earth ions are then collected using various specially designed tunnel, diversion and ditches.	
6.	OMS Plan – Detailed description on the layout setting of the ISL working platform, hydrometallurgical plant, the piping system network and other mine infrastructure and amenities.	

Table 5-18: Information on land utilisation

No.	Land utilisation			Notes
	Mine infrastructure and facility	Area (ha)	% of ML/PML	
Rare earth extraction Area (Mining Area)				
1.	Layout of the ISL platform including piping system network and reticulation.			
2.	Erosion and Sediment Control BMPs.			
3.	Access roads.			
4.	Biomass storage.			

Table 5-18: Information on land utilisation (Continued)

No.	Land utilisation			Notes
	Mine infrastructure and facility	Area (ha)	% of ML/PML	
5.	Riparian and forest reserve boundary buffer.			
Hydrometallurgical plant				
1.	Industrial site platform			
2.	Pregnant solution transfer pond			
3.	Decontamination pond			
4.	Sedimentation pond			
5.	Ore storage pond			
6.	Mine office			
7.	Mine amenities			
8.	Laboratory and samplings storage facility			
9.	Chemical and product storages			
10.	Generator sets, pumps and diesel tanks.			
11.	Machinery parking area.			
12.	Worker quarters			
	Sub-Total			
	Grand Total			

5.10 MINE DEVELOPMENT SCHEDULE

A comprehensive project development schedule (start and end) needs to be provided. The schedule shall include project activities as shown in **Table 5-19**. Example of such development schedule is as shown in **Table 5-20**.

Table 5-19: Activities and information of mine development schedule

No.	Information and particulars	Notes
Site preparation		
1.	EIA/ESCP/EMP COA compliances	
2.	Call tender/quotes	
3.	Awarding of contracts/PO	
4.	Site demarcation and surveying	
5.	Drainage construction and ESCP BMPs	
6.	Site clearing	
7.	Access road development	
8.	Mine facilities/amenities construction	
Mine and hydrometallurgical plant development		
1.	ISL platform development	

Table 5-19: Activities and information of mine development schedule (Continued)

No.	Information and particulars	Notes
2.	Tanks, pool and piping installations	
3.	Hydrological plant construction and installation	
4.	Environmental and safety monitoring system development	
Production		
1.	ISL operation	
2.	Hydrometallurgical plant operation	
3.	Data collection and monitoring	
4.	Performance analyses and mitigation measures	
5.	Mine and processing waste management	

SOP of NR-REE is for ISL Mining Operation and Processing of IAC deposit in Malaysia. The available NR-REE resources and the REC as the mine product are non-radioactive materials, in view of their natural radioactivity concentration levels are not exceeding 1.0 Bq/g or 246.5 ppm of thorium as prescribed under Second Schedule, Atomic Energy Licencing Regulations (Radioactive Waste Management) 2011.

5.11 EROSION AND SEDIMENT CONTROL

The main activities during the mine development and operation stage which may have direct impacts pertaining to erosion and sediment is the infrastructure development activity involving land clearing, filling and levelling within the project area, particularly on the hydrometallurgical plant site. Two documents which need to be prepared with respect to LDP2M2 and ESCP are the purview of JAS and JPS, respectively.

5.11.1 Land Disturbing Pollution Prevention and Mitigation Measures (LDP2M2)

LDP2M2 is an approach designed by JAS to address issues pertaining to pollution control during land distrubing activities. The forcus of LDP2M2 is on prevention mitigation and control of pollutants from the development area including major water pollutant (suspended solids) resulting from land distrubing activities.

A plan consisting of maps and/or site plans showing the existing geomorphology and land use of the site, to be overlaid with site development map that depicts the proposed land disturbing activities, inclusive of proposed area alterations and the locations of all P2M2s facilities. Construction notes which refer to general instructions of P2M2s application, shall be included in the LDP2M2 plan or may be written on a separate sheet. Method statement and layout plan to be implemented for the major land disturbing activities of the project that may cause the water pollution, particularly by suspended solids shall also

Table 5-20: Typical example of mine development schedule

Activity	Months/Weeks																											
	Month 1				Month 2				Month 3				Month 4				Month 5				Month 6				Month 7			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Site Preparation #1																												
EIA/ESCP/EMP COA Compliances	1	2	3																									
Site Demarcation and Surveying			1	2	3																							
Call Tender/Quotes				1	2	3	4																					
Awarding of Contracts/PO								1	2	3	4																	
Site Clearing												1	2	3	4	5												
Road Construction and Diversions														1	2	3	4	5										
Drainage Construction and ESCP BMPs #2											1	2	3	4	5	6	7											
ISL Platform and Hydrometallurgical Plant Development																												
Access and Platform Development														1	2	3	4											
ISL Injection Hole Drilling															1	2	3	4	5	6								
Piping System Installation																	1	2	3	4	5							
Hydrometallurgical Plant Development																		1	2	3	4	5	6					
Production																												
ISL Operation																							1	2	3	4	5	6
Hydrometallurgical Plant Operation and Production																										1	2	3
Data Collection and Monitoring												1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Performance Analyses and Mitigation Measures														1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Note:
#1 - Timeline is tentative depending on the approval process by various authorities
#2 – Subject to EMP approval as part of EIA COA

be part of the document. LDP2M2 shall cover subjects as listed in **Table 5-21**, with run-off water control and drainage system in ESCP presented in **Table 5-22**.

Table 5-21: Coverage of ESCP on NR-REE ISL mining operation

No.	Information and particulars	Notes
1.	Working phases and sequencing	
2.	Erosion control	
3.	Surface runoff control	
4.	Sediment control	
5.	Slope stabilisation	
6.	Preservation of Natural Areas	
7.	Water Quality Control and Monitoring	
8.	BMPs	
9.	Compliance Checklist	

Table 5-22: Run-off water control and drainage system in mining area

No.	Information and particulars	Notes
1.	The plan shall incorporate permanent stormwater management system which comprised of the BMPs such as sediment basins, silt traps, silt fences, earth drains to be implemented within the Project site.	
2.	The plan needs to have a well-designed network of drainage, in such a way to minimise soil erosion from the run-off on the project area.	
3.	All drains shall be designed to take maximum water run-off and at the same time control the water flow speed.	
4.	The drains shall be discharged into dedicated and designated retention pond, which will then flow into a small stream and eventually end up in the river with the discharge points properly identified.	
5.	Roads shall be constructed with a curve profile and side drains. The service road to the highest elevation should be designed to have a berm on the open side with a drain on the cliff side to direct the water to the bottom.	

5.11.2 Erosion and Sediment Control Plan (ESCP)

An ESCP is a document that identifies the methods and devices implemented to minimise erosion and sediment loss from the proposed project site as a result of mine development activities. Submission and approval of ESCP for the mining development and operation is under the purview of JPS.

The ESCP shall be prepared based the Guideline for Erosion and Sediment Control in Malaysia (JPS 2010) which recognises the unique characteristics of the project site, the

methods for avoiding the environmental effects of erosion and sediment, and who will be undertaking the implementation and monitoring of the ESCP. It is a requirement that the ESCP and its implementation shall be carried out before any ground works may commence to ensure that the impacts from the said activity and the proposed mitigation controls as outlined in the EIA are able to address the relevant impacts. Detail technical background of ESCP is attached in **Appendix 5-2**.

5.11.3 Best Management Practices (BMPs)

There are a number of different site BMPs which shall be installed for the erosion prevention and sediment control within the project site. The BMPs categories and objectives for the LDP2M2 are as listed in **Table 5-23.** These BMPs are to be planned out and subsequently applied on affected areas based on the information acquired from the development plan made available to the LDP2M2 designer. The designer shall also be required to have a sound knowledge on the topography and runoff flow direction to ensure whatever BMPs planned on-site shall be workable and practical. Should there be any modifications on-site upon implementation, it shall also be dictated on the plan to ensure the project proponent and relevant agencies be made known of the changes made.

Table 5-23: BMPs categories and objectives for ESC

BMPs Category	BMPs Objectives						
	Practice good housekeeping	Contain waste	Minimise disturbed area	Stabilize disturbed area	Project slopes and channels	Control site perimeter	Control internal erosion
Site planning considerations							
Scheduling							
Physical stabilisation							
Geotextiles and mats							
Dust control							
Waterway crossing							
Diversion of runoff							
Earth drain							
Diversion channel							
Silt trapping/filtering							
Silt fence							
Silt trap/basin							

5.12 PROCESS FLOW IN THE NEW APPLICATION AND RENEWAL OF OMS

Guidelines on the preparation of OMS is as attached in **Appendix 5-3.** The guideline, 'Interim Guideline on Preparation of an Operational Mining Scheme' (JMG 2019) contains lists of documents and information required in the application and renewal of an OMS which need to be made available and prepared accordingly. Other than the said guidelines, JMG has also outlined the process and procedure on the OMS approval through two circulars, the Circulars of JMG Director General – Circular No. 1/2018, dated 5 March 2018 and Circular No. 1/2020, dated 1 July 2020.

With the stipulated circulars, the OMS application and renewal for NR-REE mining operation under Section 10(1), Mineral Development Act 1994 shall be processed in JMG headquarters and approved by Ketua Pengarah JMG. The process for the application of a new OMS is summarised in **Table 5-24** with the process flowchart depicted in **Figure 5-1**. Work process for the renewal application would be the same as shown in **Table 5-25**.

Table 5-24: Work process on the new application of OMS

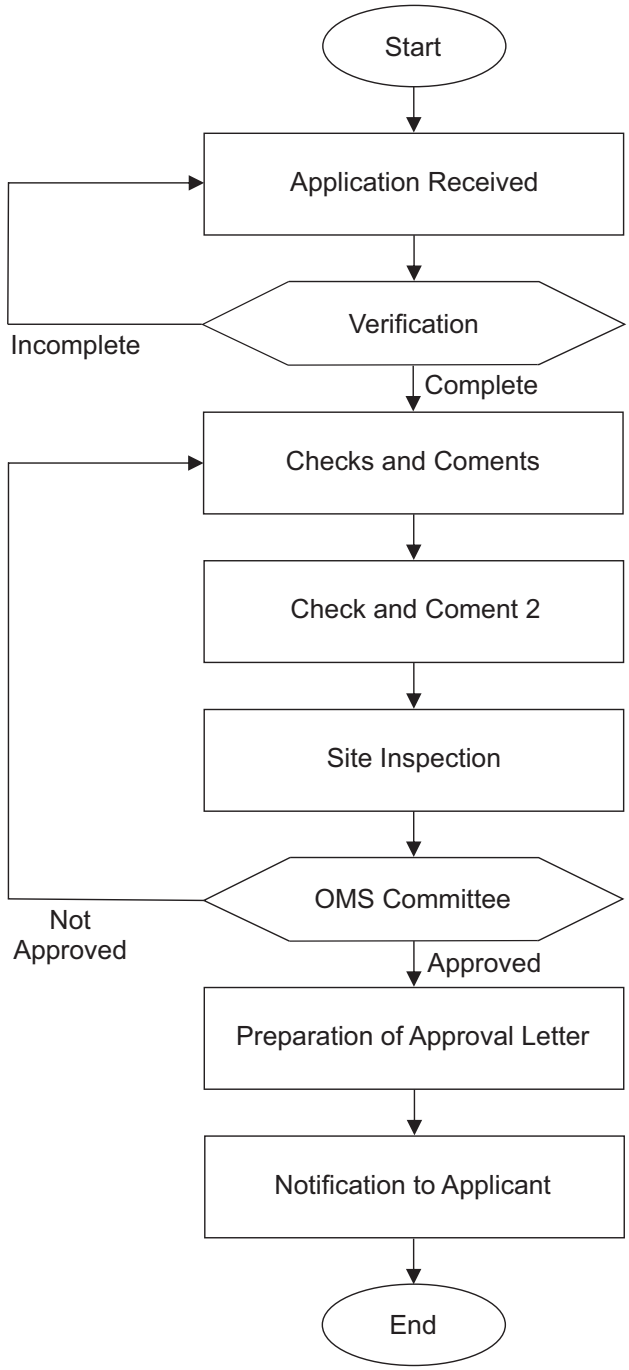
No.	Work process	Action	Remarks
1.	Application – Received and recorded	✧ Pengarah Galian (JMG) ✧ Pembantu Galian	
2.	Application verification – Check on application documents	✧ Pengarah Galian (JMG) ✧ Pembantu Galian ✧ Penolong Pengarah Galian (JMG)	
3.	Check and comment 1	✧ Pembantu Galian	
4.	Check and comment 2	✧ Penolong Pengarah Galian (JMG) ✧ Pembantu Galian Kanan	
5.	OMS assessment committee ✧ OMS member ✧ Director (JMG) ✧ Director (PTG)/On behalf ✧ Director (JAS)/On behalf ✧ Deputy Director (Mine and Quarry) ✧ Director (Other technical Department) /On behalf	✧ Penolong Pengarah Galian (JMG) ✧ Pembantu Galian Kanan	

Table 5-24: Work process on the new application of OMS (Continued)

No.	Work process	Action	Remarks
6.	Approval – Preparation draft of approval letter	✧ Pengarah Galian (JMG) ✧ Penolong Pengarah Galian (JMG) ✧ Pembantu Galian Kanan ✧ Pembantu Galian	
7.	Issuance of approval letter	✧ Pengarah Galian/Ketua Pengarah Galian (JMG)	

Table 5-25: Work process on the renewal application of OMS

No.	Work process	Action	Remarks
1.	Application – Received and recorded	✧ Pengarah Galian (JMG) ✧ Pembantu Galian	
2.	Application verification – Check on application documents	✧ Pengarah Galian (JMG) ✧ Pembantu Galian ✧ Penolong Pengarah Galian (JMG)	
3.	Check and comment 1	✧ Pembantu Galian	
4.	Check and comment 2	✧ Penolong Pengarah Galian (JMG) ✧ Pembantu Galian Kanan	
5.	OMS assessment committee ✧ OMS committee member ✧ Director of Mines (JMG) ✧ Director PTG/On behalf ✧ Director JAS/On behalf ✧ Assistant Director (Land and Mines) (JMG) ✧ Director (Other technical department)/On Behalf	✧ Penolong Pengarah Galian (JMG) ✧ Pembantu Galian Kanan	
6.	Approval – Preparation draft of approval letter	✧ Pengarah Galian (JMG) ✧ Penolong Pengarah Galian (JMG) ✧ Pembantu Galian Kanan ✧ Pembantu Galian	
7.	Issuance of approval letter	✧ Pengarah Galian/Ketua Pengarah Galian (JMG)	



Application Documents
- Certified OMS
- Form 24
- Form 49
- Memorandum & Article of Association
- Copy of Annual Quit Rent Receipt
- Copy of ML/PML
- Copy of Agreement between ML/PML Holder and Mine Operator
- EIA Approval Letter (If Any)
- Rehabilitation Plan (If Relevant)

Site Inspection
- Mineability
- ML/PML Conditions of Approvals
- Information Verification

Figure 5-1: Work process on the application of OMS

Condition of Approvals (COAs) for OMS emphasise on various pertinent issues that must be managed effectively. Circular by the Director General JMG as per Circular No. 1/2018, dated 5 Mar 2018 and Circular No. 1/2020, dated 1st July 2020 reflect the seriousness of the Authority in ensuring the needs for the industry to be managed effectively and constantly monitored. COAs form part of the required compliances to be observed by the project proponent.

ENVIRONMENTAL IMPACT ASSESSMENT 6.0

6.1 INTRODUCTION

Environmental Impact Assessment (EIA) is a range of actions to identify, predict, evaluate and assess the impacts, both beneficial and adverse with the main objective of protecting the environment and the surrounding areas where the project is located. A typical EIA report contains information for the Project Proponent to implement the mitigation measures in an environmentally friendly and socially responsible manner, while aids the relevant government agencies to make informed decisions on a project, including preparation of the Conditions of Approval (COA). At the same, the report serves the public as a document, enabling the project to be understood, with its potential impact on the environment being emphasized.

The said report needs to be prepared in accordance with the guidelines prescribed by the Director General of JAS and contains an assessment of the impact of such activity on the environment and to propose measures to be undertaken to prevent, reduce, or control the adverse impact on the environment. The preparation of this EIA Report is to ensure that the environmental feasibility of the project is determined, and that environmental management considerations are taken into account during the project formulation period.

6.2 STATUTORY REQUIREMENTS

The right to mine, for holders of ML/PML for IAC NR-REE mining and processing, is contingent on obtaining approval of EIA as prescribed in Section 64(1)(c), Mineral (Perak) Enactment 2003. For IAC NR-REE mining, the activity is a prescribed activity 8, Schedule 2 of EIA Order 2015, Environmental Quality Act 1974.

Section 34A of the Environmental Quality (Amendment) Act 1985 states that any person intending to carry out any of the prescribed activities, shall need to submit an Environmental Impact Assessment (EIA) report to the Director General of the Department of Environment (JAS), and shall need to have the report endorsed before any approval for carrying out such activity can be granted by the relevant approving authority. Details of the relevant laws, regulations and guidelines related to EIA for the said mining are listed in **Table 6-1**.

Table 6-1: Relevant laws, regulations and guidelines related to EIA of mining operation

Statutory requirements	Document/Report for approvals	Regulations/Guidelines/Notes
Section 64(1)(c), Mineral (Perak) Enactment 2003	Environmental Impact Assessment (EIA)	
Section 34(A), Environmental Quality Act 1974	Environmental Impact Assessment (EIA)	✧ EIA Order 2015 ✧ EIA Guidelines in Malaysia (EGIM) (JAS 2016) ✧ Environmental Impact Assessment Guidelines for Mining and Quarrying (2018) ✧ Guidance Document for Addressing Soil Erosion and Sediment Control Aspects in the Environmental Impact Assessment (EIA) Report (JAS 2016) ✧ Guidance Document for the Preparation of The Document on Land-Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2) (JAS 2016) ✧ Guidance Document on Health Impact Assessment (HIA) in Environmental Impact Assessment (EIA) (JAS 2012) ✧ Guidelines for Erosion and Sediment Control in Malaysia, 2010. ✧ Urban Stormwater Management Manual for Malaysia (MSMA) 2nd Edition, 2012. ✧ Guidelines for Environment Noise Limits and Control, (3rd Edition), (JAS 2019). ✧ Mineral Development (Effluent) Regulations 2016.

6.2.1 Prescribed activities under EIA Order 2015 related to NR-REE mining operation

NR-REE mining development and operation is a prescribed activity under the EIA Order 2015, thus requiring the submission of EIA report to JAS for approval. It falls under activity 8, Schedule 2, Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015. Depending on the site location of the proposed mining area, the proposed development and operation may also be subjected to other prescribe activities under the EIA Order 2015 with the details as stated in **Table 6-2**.

Table 6-2: Prescribed activity 8 and other activities, Schedule 2 EIA Order 2015

No.	Information and particulars	Notes
Activity 8, Schedule 2 of the EIA Order 2015		
1.	Mining of minerals in new areas involving large scale operation – Under the Environmental Impact Assessment Guidelines for Quarry and Mining (2018), large scale is defined as that definition of large scale mining in Section 2(1), State Mineral Enactment.	
2.	Mining of minerals within or adjacent or near to environmentally sensitive areas – The following quantum can be applied to ascertain the definition of adjacent or near. However thorough modelling and impact assessment should be carried out to ensure that the mining activities shall cause adverse impacts to the nearest receptors. Definition of the following terms shall be applicable: a) Within – Inside of Environmentally Sensitive Areas of Ranks 1, 2 and Rank 3. b) Near – Sharing a boundary with Environmentally Sensitive Areas of Rank 1, 2 and 3. c) Adjacent – Project Site is within 500m of Environmentally Sensitive Areas of Rank 1, 2 and 3.	
Activity 5, Schedule 2 of the EIA Order 2015, forestry		
1.	Conversion of forest at 300 m or more above mean sea level to other land use covering and area of 100 ha or more.	Project within forest reserve
Activity 13, First Schedule, development on slope area		
1.	Development or land clearing less than 50% of an area with slope greater than or equal to 25^0 but less than 35^0.	Subject to the site topography

6.2.2 Compatibility with local planning strategies

Section 34A, Environmental Quality Act 1974 stipulates that the Director General of JAS may only approve an EIA report for a particular project which is in-line with the Local Plan of the area. Thus, it is pertinent on the part of the Project Proponent or the project Approving Authorities to take into consideration the status of the land under consideration. In practice, JAS would like matters pertaining to the zoning issues of the project area be settled at the TOR stage of the EIA process.

6.2.3 Mine buffer zone

According to JAS latest Guidelines for Siting and Zoning for Industries, the required buffer zone for a mine to the nearest receptor within the settlement area is 500 m. Thus, under the site suitability requirement, adequate buffer zone need to be provided particularly to the nearest sensitive receptor located within 500 m radius of the project boundary. Due

care must be taken and the best environmental management practice need to be implemented in the operation of the mine.

6.3 EIA REPORT PREPARATION

The EIA and its review process are illustrated in **Figure 6-1**. This EIA process is based on the EGIM (2016) published by JAS. It provides assessors with a step-by-step guide to the process of an EIA. Details of the procedural steps for the EIA process together with the flow path for the EIA is attached in **Appendix 6-1**. EIA study shall follow typical steps and phases, commonly followed by EIA practitioners, and they are as presented in **Table 6-3**.

6.3.1 EIA Terms of Reference (TOR)

TOR sets the objectives, defines the scope, and establishes the strategy and schedule for the EIA process to address all the pertaining issues. TOR is the product of the scoping process where the scoping identifies the key environmental impacts and issues of concern that are required to be considered in detail during the EIA for the project. The TOR will define which types of information obtained from the scoping process, are to be presented in the EIA Report, as listed in **Table 6-4**.

6.3.2 Background information of the mining project

The background information of the project for the purpose of EIA report are as listed in **Table 6-5**, where most of the information are similar as those listed in **Table 5-7** of the SOP. Some information in the form of certified copies, shall need to be made available to the appointed EIA consultant, for preparation and submission of the EIA report to JAS.

6.3.3 Project details

Descriptions of the project details shall be presented under various headings as required under the new EIA guidelines produced by the EGIM (2016). Maps, plans, diagrams and photographs are used in the illustration of the related subject matters. A typical list of the project details which are required to be described are as shown in **Table 6-6**.

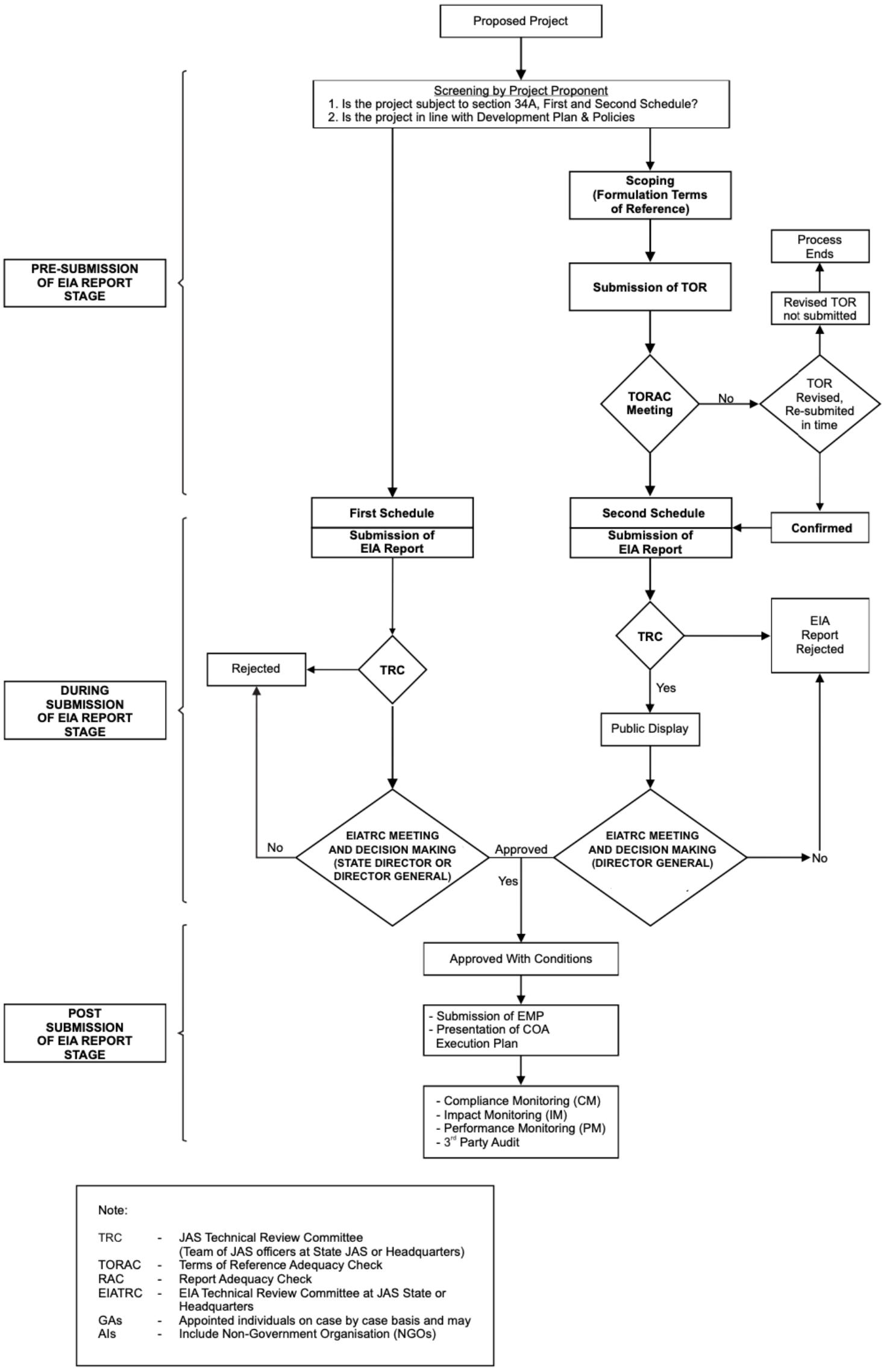


Figure 6-1: General overview of EIA procedure

Table 6-3: Steps and phases of EIA study

No.	Steps and phases	Notes
1.	Screening	
2.	Scoping towards formulation of tor	
3.	Baseline study	
4.	Impact assessment and evaluation of significance	
5.	Identification of mitigation measures	
6.	EIA report preparation	
7.	EIA report review	
8.	Decision making	
9.	Project implementation and environmental monitoring	
10.	Environmental audit	

Table 6-4: Information obtained from the EIA scoping process

No.	Information	Notes
1.	To specify what studies will be performed	
2.	To identify who will conduct the studies	
3.	To state when the studies will be carried out and the study timeline	
4.	To outline the methodologies to be used in impact assessment and evaluation of significance.	

Table 6-5: Background information of the mining project

No.	Information from EIA scoping process	Notes
Introduction to the mining project		
1.	Project title	
2.	The project	
3.	Project location	
4.	Mineral tenement	
5.	Project proponent	
7.	EIA consultant	
8.	Environmental legislative requirement	
9.	Objectives of the EIA	
Terms of Reference		
1.	Environmental scoping information	
2.	TOR checklist	
Statement of Need		
1.	REEs	
2.	NR-REEs	
3.	IAC RE resources	
4.	Supply and demand	
5.	Project justification	

Table 6-5: Background information of the mining project (Continued)

No.	Information from EIA scoping process	Notes
Project Options		
1.	Site options	
2.	Mining method options	
3.	Project comparison with similar project in Malaysia	
4.	No project option	

Table 6-6: Description of the project details

No.	Project details	Notes
Project concept		
1.	The concept	
2.	Project size and capacity	
3.	Land requirements	
4.	Raw materials	
5.	Special infrastructural requirements	
RE reserve		
1.	Characteristics of the NR-REE deposit	
2.	RE reserve estimations	
3.	Production capacity and mine life	
Project layout and components		
1.	OMS	
2.	Land utilization	
3.	Piping network reticulation and collection system	
4.	Tanks and collection pools	
5.	Hydrometallurgical plant	
6.	Main raw materials storage area	
7.	Main mine products storage area	
Project activities		
1.	Investigation stage	
2.	Development stage	
3.	Operation and production stage	
4.	Rehabilitation stage	
5.	Post operation and abandonment stage	
Project requirements		
1.	Manpower requirements	
2.	Chemical requirements	
3.	Electrical power supply requirements	
4.	Water supply	
5.	Mine office	
6.	Mine facilities and amenities	
7.	Working hours	

Table 6-6: Description of the Project Details (Continued)

No.	Project Details	Notes
Project Development and Operation Schedule		
1.	Site preparation	
2.	Mine and hydrometallurgical plant development	
3.	Production	

6.3.4 Existing Environment

The features of the physical, biological and socio-economic environment, relevant to the proposed project shall be examined. Among the objectives are to establish the baseline, with regard to the existing conditions prior to the commencement of the development and mining phases. The zone of study for the EIA is 5 km in radius from the proposed project site, and this is deemed as the area which is likely to experience impact as a result of the project implementation. **Table 6-7** presents a list of subjects which need to be examined under the existing environment of the project area.

Table 6-7: Description of the existing environment

No.	Subjects	Notes
Physical environment		
1.	Regional geology ✧ Lithological features ✧ Geomorphological features	
2.	Site Geology ✧ General conditions ✧ Slope stability	
3.	Topography	
4.	Terrain evaluation	
5.	Hydrology and hydrogeology	
6.	Environmental baseline samplings	
7.	Meteorology	
8.	Radioactivity	
9.	Soil composition	
Biological environment		
1.	Flora	
2.	Fauna	
3.	Surface water ecology	
Land use		
1.	Environmental sensitive receptors and areas	
2.	Environmental sensitive areas (ESA)	
3.	Existing land use within proposed project site	
4.	Existing land use within 5 km radius	
5.	Future land-use around proposed project site	

Table 6-7: Description of the existing environment (Continued)

No.	Subjects	Notes
Human environment		
1.	Regional profile	
2.	Social economic profile	
3.	Engagement with relevant stakeholders and agencies	
4.	Public health	
Infrastructure and utilities		
1.	Infrastructures	
2.	Electricity	
3.	Water supply	
4.	Telecommunication	

6.3.5 Evaluation of environmental impacts

During the impact assessment phase of the EIA study, the impacts of the proposed project are determined. The impacted sectors could be environmental, socio-economic, health, etc. To identify and assess the magnitude of potential impacts associated with or resulting from project activities, a number of methodologies have been developed and used worldwide. **Table 6-8** shows some of these methodologies which shall be utilised in the EIA of the project.

Table 6-8: Methodologies in the impact assessment and evaluation of significance

No.	Information from EIA scoping process	Notes
1.	Expert judgement	
2.	Checklist and matrices	
3.	Multi-criteria analysis	
4.	Mathematical models and simulation	
5.	Case comparison	
6.	Geospatial analysis	

The potential impacts that the project could impose on the surrounding environment, during both its preparation, operation and abandonment stages shall be examined. It will attempt to identify and assess the equilibrium displacements that could be experienced by specific environmental receptors, as a result of the activities that will be carried out during all stages of the project. **Table 6-9** presents a list of areas which need to be examined with respect to possible environment impacts of the project.

Table 6-9: Evaluation of environmental impacts

No.	Subjects	Notes
Surface water quality		
1.	Hydrological analysis	
2.	Hydraulic modelling	
3.	Water quality modelling	
4.	Water quality impact assessment	
Groundwater quality		
1.	Groundwater flow direction at project site	
2.	Existing groundwater wells used for potable purposes	
3.	Numerical modelling approach and modelling codes	
4.	Conceptualization of the processes	
5.	Groundwater model calibration	
6.	Groundwater modelling and results	
7.	Vertical concentration profiles	
8.	Groundwater quality impact assessment	
Soil erosion assessment		
1.	Estimation of soil erosion rates	
2.	Soil loss estimation	
3.	Sediment yield estimation	
Ecology		
1.	Flora	
2.	Fauna	
3.	Surface water ecology	
Air quality		
1.	Development stage	
2.	Operation stage	
Noise		
1.	Acceptable noise limits	
2.	Prediction tools	
3.	Development stage	
4.	Operation stage	
Health Impact Assessment (HIA)		
1.	Hazards identification and dose response	
2.	Exposure assessment	
3.	Health risk assessment	
Waste management		
1.	Scheduled waste	
2.	Solid waste	
3.	Vegetation waste	
Review on possible radionuclide leaching and partitioning		
1.	Introduction	
2.	Possible routes of radionuclide partitioning	

Table 6-9: Evaluation of environmental impacts (Continued)

No.	Subjects	Notes
Economic valuation of environmental impacts		
1.	Methodology	
2.	Study findings	
3.	Aggregated economic values of external impacts of the project	

6.3.6 Mitigation measures

Mitigation measures are necessary to address issues of concern, on the equilibrium displacements that could be experienced by specific environmental receptors. This is viewed as a result of the activities that will be carried out during all stages of the project.

Mitigation measures are necessary to address matters of apprehension, to ensure that the impacts will not have any negative bearing to the surrounding. Mitigation measures can be carried out either through engineering innovation or through management practices. However, cost benefits analysis needs to be taken into consideration in the evaluation of alternatives. **Table 6-10** presents a list of possible impacted receptors as a result of the activities that will be carried out, which require certain mitigation measures to be undertaken.

Table 6-10: List of possible impacted receptors and mitigation measures

No.	Impacted receptors	Notes
Introduction		
1.	Prevention	
2.	Control	
3.	Compensatory	
Surface water quality		
1.	Development stage	
2.	Operation stage	
3.	General mitigating measures	
Groundwater quality		
1.	Unconfined groundwater	
2.	Geological condition and stability of bedrock	
LDP2M2		
1.	Implementation of erosion and sedimentation control measures	
2.	Project's BMPs	

Table 6-10: List of possible impacted receptors and mitigation measures (Continued)

No.	Impacted receptors	Notes
Ecology		
1.	Terrestrial flora	
2.	Terrestrial fauna	
3.	Surface water ecology	
4.	Riparian management plan	
Air Quality		
1.	Degree of impacts	
2.	Mitigation measures	
Noise		
1.	Source and degree of impacts	
2.	Mitigation measures	
Health risk management		
1.	Communicable diseases	
2.	Surface water and groundwater	
Waste management		
1.	Waste types and quantity	
2.	Mitigation measures	
Social Management		
1.	Corporate Social Responsibility (CSR)	
2.	Mitigation measures	
Other Related Features		
1.	To establish Communication, Education and Public Awareness (CEPA)	
2.	Local community and stakeholders engagement	
3.	Natural disaster preparedness	
4.	Mitigation measures	

All feasible mitigation measures shall be incorporated in the proposed project. Pollution prevention, minimization and mitigation measures shall be incorporated and part of the proposed project facilities design. **Table 6-11** describes the basic mitigation and monitoring elements required on the surface water and groundwater related to the project site.

Table 6-11: Surface water and groundwater mitigation measures

No.	Mitigation measures	Notes
Surface water – Development stage		
1.	Avoidance of the riparian area in the construction of plants and pipeline	
2.	Phases construction of plants and pipeline system	
3.	Measures to protect unpaved surfaces and road	

Table 6-11: Surface water and groundwater mitigation measures (Continued)

No.	Mitigation measures	Notes
4.	Perimeter earth drain/diversion channel to divert surface water from mining area to silt trap prior discharge	
5.	Protection on temporary construction waste stockpile to prevent splash erosion from rainfall	
6.	Maintenance and repairing, as necessary of the control measures installed	
Surface water – Mining stage – Hydrometallurgical plant		
1.	Placement of drip collection devices to all chemical tanks and storage areas and be sited on sealed areas with a bund enclosure	
2.	Usage of impervious lining in pools to prevent seepage of solution into the soil.	
3.	Adoption of a multi-tank alternate use scheme, and will always maintain one decontamination pool and one empty sedimentation pool. The empty tanks will act as primary emergency storage during heavy rain.	
4.	Establishment of an emergency pool downstream of each hydrometallurgical plant to collect any extra volume of water	
5.	If required, another two (2) emergency pools at the foothill of the operating ore bodies in case the volume of stormwater exceeds the capacity of the plant.	
6.	Installation of a treatment capacity WWTP at each plant, as operating unit and as stand-by unit	
7.	Adoption of alternate use scheme periodically to ensure the functionality and prolong the longevity of the WWTPs.	
8.	Placement of stormwater drains surrounding the processing pools to divert the external stormwater, preventing them from entering the pools	
Surface water – Mining stage – ISL area/ore body		
1.	Installation of check valves and leak alarm devices in the leaching solution transporting pipeline with at regular distance intervals.	
2.	Immediate cease of transportation/injection, in case of accidental leak	
3.	Installation of accident pools at the downstream of the leaching solution transporting pipeline at a certain interval.	
4.	Construction of stormwater diversion ditch at the upstream and parallel with the pregnant solution collection drains to divert most of the surface runoff, preventing most of the stormwater from entering the collection drains. The diverted natural stormwater will be discharged into the nearby river.	

Table 6-11: Surface water and groundwater mitigation measures (Continued)

No.	Mitigation measures	Notes
5.	Establishment of collection drains to collect stormwater in the pregnant solution to hydrometallurgical plant. In case of excessive water exceeding the storage capacity of the provide pools, the collected rain water will be treated at WWTP before being discharged.	
Groundwater – Mining stage		
1.	Establishment on the existence of major fracture zones, by trial injection with clean water.	
2.	Usage of impervious lining for the pregnant solution collection tunnels and collection drains	
3.	Identification existing wells to be used as monitoring wells.	
4.	Strictly assessment on the groundwater monitoring programme.	
5.	Properly construction of groundwater monitoring wells.	
Other related features		
1.	To periodically assess the surface water and groundwater monitoring data to establish the effectiveness of the mitigation measures undertaken.	
2.	To improve where necessary all BMPs established to address the surface run-off water and other mitigation measures related to the groundwater.	
3.	All monitoring data to be appropriately managed.	

6.3.7 Environmental Management Plan (EMP)

The EMP establishes a strategy to manage environmental issues throughout all stages of the development. It also provides a framework specification, upon which the project proponent will set the environmental control requirements for the proposed project. **Table 6-12** outlines components of the EMP, which contains a written description of the proposed measures to be implemented, in order to achieve and maintain acceptable levels of environmental impact. Details of the EMP for a proposed ISL mining of NR-REE IAC deposit is presented in **Chapter 7.0** of this SOP.

Table 6-12: Components of EMP

No.	Subjects	Notes
1.	Environmental mainstreaming and self-regulation	
2.	EMP	
3.	Monitoring programs	
4.	Environmental auditing	
5.	Environmental contingency plan	

6.4 DOCUMENTATION OF EIA REPORT

The EIA report is the document which needs to be prepared for submission to JAS for approval. The report covers information, specific studies and documents to support both the legal and technical requirements of the approval process as provided by EGIM (JAS 2016).

6.4.1 Submission of document

Submission of EIA report to JAS is in the form of printed hard copy (stipulated number of copies) which shall be distributed further to the relevant authorities related to the project. In order to aid the review process, the EIA report shall be submitted to JAS in the format as specified in **Table 6-13.**

Table 6-13: Format of the EIA report for submission to JAS

No.	Format of the EIA report for submission	Notes
1.	Soft copy version (portable document format - PDF) of the Executive Summary shall be submitted to JAS (EIA Secretariat) and also to the State JAS office.	
2.	Soft copy of the full EIA Report to JAS (EIA Secretariat). The softcopy will be uploaded to the Enviro Knowledge Management Centre (EKMC) and website of JAS for public display.	

These will be copied and used for the public comment process, as well as being available to other departments/agencies that would have a critical role in the evaluation of the report.

6.4.2 Contents of EIA report

Guidance document for preparing Terms of Reference (TOR) and the preparation of the EIA Report have clearly been prescribed in EGIM (JAS 2016).

The main text shall focus on finding, conclusion and recommended actions, supported by summaries and analyses of the data collected, as well as citations for any references used in their interpretation. Unpublished documents and detailed data must be presented in appendices. Where the EIA utilises the results of previously conducted research, appropriate references and a listing of individuals and organizations consulted must be included. The public availability of data and studies utilised shall also be indicated. Methodologies for all data collection and analyses (including quality control measures) must be included in relevant appendices. Wherever practical, maps, flow diagrams, charts and photographs directly referred to in the main text shall be included in the

relevant section of the main body of the document. Table of contents as stipulated in EGIM (JAS 2016) are detailed in **Appendix 6-1**.

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.0

7.1 INTRODUCTION

The framework for the EMP for a proposed mine development and operation, has been outlined in **Section 6.3.7, Table 6-11** of the SOP. It is part of the EIA component as stipulated in EIA Guidelines in Malaysia. Upon approval of the EIA, it is a requirement for the project proponent to submit an EMP for the project and this needs to be approved before the said project may be allowed to proceed. EMP translates the pollution prevention and mitigation measures (P2M2s) proposed in the EIA Report and the approval conditions (COAs) into action. JAS has published guidelines for the preparation of EMP as specified in Chapter 6 of the EGIM (2016).

7.2 PRINCIPLES OF EMP

The EMP document states in explicit terms what actions will be taken, what measures will be instituted, what structures will be built, what will be installed, when the actions will be executed, in order to incorporate the P2M2s in the project activities and for the project activities to be compliant with the COAs. The EMP is a concrete plan of action which is explicit, illustrative, action-oriented, time-bound and definitive. The EMP is by nature a living document which needs to be revised and updated when there exist certain circumstances which demand changes to be made. These factors may include changes to project details and surrounding areas, and inadequacy of the control measures to comply with regulatory standards.

7.2.1 Objectives of EMP

An Environmental Management Plan (EMP) is an institutional arrangement through which environmental impacts could be controlled. The objectives of an EMP are as summarized in **Table 7-1**.

Table 7-1: Objectives of EMP

No.	Objectives	Notes
1.	Identify the set of responses to mitigate potentially adverse impacts	
2.	Determine requirements to meet the responses effectively and timely	
3.	Describe the means for meeting the requirements	
4.	Provide feedback information to be used by executing agency and other in evaluating projects' interactions with the environment.	
5.	Identify the set of responses to mitigate potentially adverse impacts	

7.2.2 Environmental mainstreaming and self-regulation

In the spirit of cultivating environmental excellence, JAS has embarked on a guided self-regulation program. The program shall guide and require the Project Proponent and his competent team to self-regulate, in ensuring environmental performances and compliances in all of its project activities. In order to assist the regulated community to achieve the state of self-regulation, JAS has formulated a set of environmental mainstreaming tools (EMTs) as listed in **Table 7-2**.

Table 7-2: Environmental mainstreaming tools

No.	Mainstreaming tools	Notes
Environmental policy		
1.	Strong and unequivocal statements to convey their environmental commitments to their employees, clients, stakeholders and the public.	
2.	Disseminated to all relevant parties and translated into action all work procedures, materials, purchasing policy, decision making process and cascades down to the supply chain	
Environmental budgeting		
1.	To allocate sufficient budget for environmental related costs such as in-situ testing equipment and rain gauge.	
2.	Provision of personnel and relevant trainings and installation of Pollution prevention and mitigation measures.	
Environmental monitoring committee		
1.	To promote collective responsibility to be environmentally compliant.	
2.	Two monitoring committees to be formed, one at the working level and the other at the policy level.	
Environmental facility		
1.	To establish a mini laboratory to enable in getting immediate results on the performance of the P2M2 on-site.	
2.	To equip the mini laboratory with in-situ testing equipment, rain gauge and other basic testing equipment.	

Table 7-2: Environmental mainstreaming tools (Continued)

No.	Environmental tools	Notes
Environmental competency		
1.	Relevant personnel in discharging various environmental responsibilities need to possess competencies.	
2.	To draw up a comprehensive training program to produce competent persons and trained staff.	
Environmental reporting and communication		
1.	To establish a formal communication channel for reporting on environmental concerns and system upsets which warrant prompt actions to be instituted.	
2.	To initiate Internal reporting on a regular basis the regulatory compliance status of the organization to the head of organization and various heads of department	
3.	To disseminate updates of new environmental requirements and their implications to the relevant company personnel through such communication channel.	
2.	Environmental reporting and communication require systematic analysis of performance monitoring data, summarized in appropriate format for easy understanding and communication and maintained for management review purposes.	
Environmental transparency		
1.	To encourage more transparent in environmental compliance and achievement.	
2.	To display compliance status on company website or billboard located at the boundary or entrance to the company's premise, or communicated to be the immediate neighbours through issuance of fliers on a scheduled basis.	
3.	To prepare Environmental Sustainability Report (ESR) to showcase its success in managing the environmental concerns of the company and minimizing the environmental footprint of its business.	

7.3 COMPONENTS OF EMP

The preparation and submission of EMP, is based on EGIM (2016). An EMP is a document containing the organizational structure, responsibilities, procedures, and resources to deal with all relevant environmental issues and to achieve effective and long-term compliance in environmental protection. It intends to outline the actions to be taken to manage the impacts from the project activities. Components of EMP for submission to JAS are as shown in **Table 7-3** while a checklist of information related to the EMP is presented in **Table 7-4**.

Table 7-3: Components of EMP

No.	Subjects	Notes
Environmental mainstreaming and self-regulation		
1.	Environmental mainstreaming tools ✧ Environmental policy ✧ Environmental budgeting ✧ Environmental facility ✧ Environmental competency ✧ Environmental reporting and communication ✧ Environmental transparency	
2.	Environmental mainstreaming tools compliance report	
EMP		
1.	Introduction	
2.	Environmental policy	
3.	Organisation chart, responsibility and implementation budget	
4.	Environmental requirements	
5.	Monitoring programs	
6.	Management plans	
7.	Environmental contingency plan	
8.	Conclusion	
Monitoring programs		
1.	Environmental monitoring programs	
Environmental auditing		
1.	Objectives	
2.	Compliances	
Environmental contingency plan		
1.	Objectives	
2.	Emergency Response Plan (ERP)	

Table 7-4: Checklist of EMP subject coverage

No.	Subjects	Notes
1.	Approved project layout plan	
2.	Project implementation schedule	
3.	Name of EMP preparer	
4.	Corporate policy statement of environmental management and protection	
5.	Commitment by the top management on the mainstreaming of environmental agenda	
6.	Instilling of self-regulation in the development project	
7.	Ensuring continuous compliance with the environmental regulatory requirements.	
8.	Organization chart of the project proponent top management with responsibilities on environmental management and protection	

Table 7-4: Checklist of EMP subject coverage (Continued)

No.	Subjects	Notes
9.	Contact details of Environmental Manager, Environmental Officer (EO), Engineering Consultants, Contractors, Site Supervisors and other competent Personnel	
10.	Name of the relevant environmental consultant and accredited laboratory	
11.	Plan for staff training in order to develop competency to discharge responsibilities on environmental requirements and compliance	
12.	EIA COAs	
13.	LDP2M2 document	
14.	P2M2s to be implemented	

7.4 POLLUTION CONTROL AND MONITORING PROGRAM

Monitoring is an integral part of compliance audit. This section will provide the existing and recommended monitoring program, which include parameters, locations and frequencies of monitoring. Monitoring program is necessary for quality assurance. Monitoring is defined as a range of activities needed for quality assurance. Monitoring program involve measuring and recording of physical social variables, associated with development of impacts. These impacts include air pollution, water pollution, noise pollution, accident reporting and public safety.

The monitoring program is necessary as it identifies existing problems, evaluates the effectiveness of the mitigating program as well as other regulatory management activities, and assesses compliance with regulation and criteria. Monitoring therefore improves mine management. Monitoring is also useful for successful auditing and provides effective commitment for appropriate mitigating measures.

7.4.1 Environmental monitoring

Periodical monitoring is important to check on the performance of control measures, initiated to control and minimize the impact to the environment. This is also to ensure that the potential residue impact remains insignificant. Monitoring is necessary in ensuring compliance with the limits imposed through guidelines, regulation and statutory requirements. Monitoring will help in determining the liability, especially of the project management, if any. It will also help to ensure that only qualified personnel are involved in the management and operation of the project. The impact to be monitored and the frequency of the environmental monitoring for post-EIA compliance are as stated in the EIA COAs.

Each time when the analyses of the environmental monitoring are completed, any significant changes (anomalies) in the parameters studied should be reported immediately to JAS. There are a few monitoring requirements and environmental monitoring report frequency based on regulations as stated in the EIA Report approval conditions.

Environmental monitoring programs can be grouped into three types; performance monitoring, compliance monitoring, and impact monitoring. Some environmental monitoring locations will start progressively in accordance with the commencement of mining activities at the planned ore bodies site and operation of the hydrometallurgical plants.

7.4.2 Surface water and groundwater monitoring program

A monitoring programme should be designed to investigate whether surface water and groundwater are being contaminated by a point or non-point source of contaminant. This should be commenced as soon as feasible by measuring and collecting data on regular basis. Rainfall data and chemical analyses of water samples from springs and wells are also required to provide information about the quality and quantity of water moving into and out of the groundwater system. Furthermore, it also can be used to measure (directly or indirectly), impacts related to the problems being studied.

Table 7-5 presents a typical surface water and groundwater monitoring program for a Proposed NR-REE Mining Project. It shows basic study (typical) in the selection of surface water intake points and groundwater monitoring wells, as well as the parameters for analysis.

7.4.3 Environmental auditing

Working in tandem with the quantitative feedback mechanism, is the compliance program which serves as a qualitative checks and review for on-site environmental management. As such, it shall also be formulated for the EMP and mainly entails site investigation and field survey to evaluate presence and efficiency of mitigating measures. Conducted by the appointed environmental consultant, the procedures shall establish the level of on-site compliance to environmental requirements. As a norm, it is necessary for yearly audit cycle to be carried out during the entire life of the mine.

Table 7-5: Typical monitoring programs for a proposed NR-REE mining project

No.	Types of monitoring/ Proposed parameters	Proposed monitoring points	Compliance requirement/reference	Proposed frequency	Remarks
Impact Monitoring					
Surface Water – Basic Parameters					
1.	Temperature	✧ Monitoring point established during the EIA study. ✧ Locations to be described, justified and coordinated.	✧ National Water Quality Standards for Malaysia, Standard IIA ✧ Baseline established during the EIA study	Quarterly	
2.	pH				
3.	Dissolved Oxygen				
4.	Turbidity				
5.	Total Suspended Solid				
6.	Oil and Grease				
7.	Ammoniacal Nitrogen				
8.	COD				
9.	BOD				
10.	Total Coliform				
11.	Faecal Coliform				
12.	Sulphate				
13.	SO_4^{2-}				
13.	Nitrite				
14.	Nitrate				
Surface Water – Heavy Metals					
1.	Aluminium (Al)	✧ Monitoring point established during the EIA study. ✧ Locations to be described, justified and coordinated.	✧ National Water Quality Standards for Malaysia, Standard IIA ✧ Baseline established during the EIA study	✧ Monthly during mining ✧ Quarterly post mining for 1 year	
2.	Antimony (Sb)				
3.	Arsenic (As)				
4.	Barium (Ba)				
5.	Beryllium (Be)				
6.	Boron (B)				
7.	Cadmium (Cd)				
8.	Total Chromium (Cr)				
9.	Cobalt (Co)				
10.	Copper (Cu)				
11.	Iron (Fe)				
12.	Lead (Pb)				
13.	Manganese (Mn)				
14.	Nickel (Ni)				
15.	Selenium (Se)				
16.	Silver (Ag)				
17.	Tin (Sn)				
18.	Vanadium (V)				
19.	Zinc (Zn)				
20.	Cyanide (CN)				
21.	Mercury (Hg)				

Table 7-5: Typical monitoring programs for a proposed NR-REE mining project (Continued)

No.	Types of monitoring/ Proposed parameters	Proposed monitoring points	Compliance requirement/reference	Proposed frequency	Remarks
Surface Water – REEs (Only applicable once mining starts)					
1.	Lanthanum (La)	✧ Monitoring point established during the EIA study. ✧ Locations to be described, justified and coordinated.	✧ National Water Quality Standards for Malaysia, Standard IIA ✧ Baseline established during the EIA study	✧ Quarterly post mining for 1 year	
2.	Cerium (Ce)				
3.	Praseodymium (Pr)				
4.	Neodymium (Nd)				
5.	Promethium (Pm)				
6.	Samarium (Sm)				
7.	Europium (Eu)				
8.	Gadolinium (Gd)				
9.	Terbium (Tb)				
10.	Dysprosium (Dy)				
11.	Holmium (Ho)				
12.	Erbium (Er)				
13.	Thulium (Tm)				
14.	Ytterbium (Yb)				
15.	Lutetium (Lu)				
16.	Scandium (Sc)				
17.	Yttrium (Y)				
Groundwater (Unconfined, shallow wells) (To be carried out during mining and one (1) more year post mining)					
1.	Total coliform	✧ Confined groundwater well locations to be determined and shall be established at ML/PML at the lowest point (downstream from the ore bodies).	✧ National Groundwater Quality Standards for Conventional Raw Water Treatment (Drinking Water) in Malaysia ✧ National Drinking Water Quality Standards (NDWQS) ✧ Groundwater Standard and Index Edition 2019 ✧ Baseline to be established prior to mining operation	✧ Monthly during mining ✧ Quarterly post mining for 1 year	
2.	Faecal Coliform				
3.	Turbidity				
4.	Colour				
5.	pH				
6.	Temperature				
7.	Conductivity				
8.	Total Threshold Value				
9.	Chloride				
10.	Oil & Grease				
11.	Ammonia				
12.	COD				
13.	BOD				
14.	MBAS				
15.	Nitrate				
16.	Nitrite				
17.	Hardness				
18.	Fluoride				
19.	Iron				
20.	Manganese				
21.	Mercury				

Table 7-5: Typical monitoring programs for a proposed NR-REE mining project (Continued)

No.	Types of monitoring/ Proposed parameters	Proposed monitoring points	Compliance requirement/reference	Proposed frequency	Remarks
22.	Cadmium				
23.	Arsenic				
24.	Cyanide				
25.	Lead				
26.	Chromium				
27.	Copper				
28.	Zinc				
29.	Sodium				
30.	Sulphate				
31.	Selenium				
32.	Silver				
33.	Magnesium				
34.	Potassium				
35.	Calcium				
36.	Carbonate				
37.	Chloride				
38.	Pesticides				
39.	Phenol				
40.	Nickel				
41.	Gross alpha				
42.	Gross beta				
Groundwater – REEs					
1.	Lanthanum (La)	Confined groundwater well locations to be determined and shall be established at ML/PML at the lowest point (downstream from the ore bodies).	✧ National Groundwater Quality Standards for Conventional Raw Water Treatment (Drinking Water) in Malaysia ✧ National Drinking Water Quality Standards (NDWQS) ✧ Groundwater Standard and Index Edition 2019 ✧ Baseline to be established prior to mining operation	✧ Monthly during mining ✧ Quarterly post mining for 1 year	
2.	Cerium (Ce)				
3.	Praseodymium (Pr)				
4.	Neodymium (Nd)				
5.	Promethium (Pm)				
6.	Samarium (Sm)				
7.	Europium (Eu)				
8.	Gadolinium (Gd)				
9.	Terbium (Tb)				
10.	Dysprosium (Dy)				
11.	Holmium (Ho)				
12.	Erbium (Er)				
13.	Thulium (Tm)				
14.	Ytterbium (Yb)				
15.	Lutetium (Lu)				
16.	Scandium (Sc)				
17.	Yttrium (Y)				

Table 7-5: Typical monitoring programs for a proposed NR-REE mining project (Continued)

No.	Types of monitoring/ Proposed parameters	Proposed monitoring points	Compliance requirement/reference	Proposed frequency	Remarks
Groundwater (Confined, deep wells) (To be carried out during mining and one (1) more year post mining)					
1.	Total coliform	✧ Monitoring point established during the EIA study ✧ Additional confined groundwater well locations to be determined and shall be established at each mining land lot at the lowest point (downstream from the ore bodies).	✧ National Groundwater Quality Standards for Conventional Raw Water Treatment (Drinking Water) in Malaysia ✧ National Drinking Water Quality Standards (NDWQS). ✧ Groundwater Standard and Index Edition 2019. ✧ Baseline to be established prior to mining.	✧ Monthly during mining ✧ Quarterly post mining for one (1) year	
2.	Faecal Coliform				
3.	Turbidity				
4.	Colour				
5.	pH				
6.	Temperature				
7.	Conductivity				
8.	Total Threshold Value				
9.	Chloride				
10.	Oil & Grease				
11.	Ammonia				
12.	COD				
13.	BOD				
14.	MBAS				
15.	Nitrate				
16.	Nitrite				
17.	Hardness				
18.	Fluoride				
19.	Iron				
20.	Manganese				
21.	Mercury				
22.	Cadmium				
23.	Arsenic				
24.	Cyanide				
25.	Lead				
26.	Chromium				
27.	Copper				
28.	Zinc				
29.	Sodium				
30.	Sulphate				
31.	Selenium				
32.	Silver				
33.	Magnesium				
34.	Pesticides				
35.	Phenol				
36.	Nickel				
37.	Gross alpha				
38.	Gross beta				

Table 7-5: Typical monitoring programs for a proposed NR-REE mining project (Continued)

No.	Types of monitoring/ Proposed parameters	Proposed monitoring points	Compliance requirement/reference	Proposed frequency	Remarks
Groundwater – REEs					
1.	Lanthanum (La)	✧ Monitoring point established during the EIA study ✧ Additional confined groundwater well locations to be determined and shall be established at each mining land lot at the lowest point (downstream from the ore bodies).	✧ National Groundwater Quality Standards for Conventional Raw Water Treatment (Drinking Water) in Malaysia ✧ National Drinking Water Quality Standards (NDWQS) ✧ Groundwater Standard and Index Edition 2019 ✧ Baseline to be established prior to any mining work	✧ Monthly during mining ✧ Quarterly post mining for 1 year	
2.	Cerium (Ce)				
3.	Praseodymium (Pr)				
4.	Neodymium (Nd)				
5.	Promethium (Pm)				
6.	Samarium (Sm)				
7.	Europium (Eu)				
8.	Gadolinium (Gd)				
9.	Terbium (Tb)				
10.	Dysprosium (Dy)				
11.	Holmium (Ho)				
12.	Erbium (Er)				
13.	Thulium (Tm)				
14.	Ytterbium (Yb)				
15.	Lutetium (Lu)				
16.	Scandium (Sc)				
17.	Yttrium (Y)				
Ambient Air					
1.	PM10	Monitoring point established during the EIA study	✧ Malaysian Ambient Air Quality Standard 2020 ✧ Baseline established during the EIA study	Quarterly	
2.	Sox				
3.	Nox				
Noise					
1.	Leq	Monitoring point established during the EIA study	✧ Baseline established during the EIA study ✧ Guidelines for Environmental Noise Limits and Control 2019	Quarterly	
2.	Lmax				
3.	Lmin				
4.	L10				
5.	L90				
Compliance Monitoring					
Discharge from Sediment Basins (During development of hydrometallurgical plant)					
1.	Turbidity	Sampling at discharge point of sediment basins	✧ Total Suspended Solids: 50mg/l ✧ Turbidity: 250NTU	Monthly or after rainfall event of ≥12.5mm	
2.	Total Suspended Solids				
Discharge from WWTP (During heavy rain and clear water cleaning stage)					
1.	Ammoniacal Nitrogen	Sampling at discharge point of WWTP	Mineral Development (Effluent) Regulations 2016	Whenever WWTP is in used during heavy rain and monthly during clear water cleaning stage	
2.	Aluminium				
3.	Arsenic				
4.	BOD5 at 20°C				
5.	Cadmium				
6.	Iron				
7.	Lead				

Table 7-5: Typical monitoring programs for a proposed NR-REE mining project (Continued)

No.	Types of monitoring/ Proposed parameters	Proposed monitoring points	Compliance requirement/reference	Proposed frequency	Remarks
8.	Mercury				
9.	Oil and Grease				
10.	pH Value				
11.	Sulphide				
12.	Total Suspended Solids				
13.	Total Dissolved Solids				
14.	Temperature				
15.	Copper				
16.	Manganese				
Radionuclide activity concentration					
1.	Ra-226	Samples of pregnant solution, sludge and product from each hydrometallurgical plant	AELB Guideline on Radioactivity LEM/TEK74	Quarterly	
2.	Ra-228				
3.	K-40				
4.	Th-228				
5.	Th-230				
6.	Th-232				
7.	U-234				
8.	U-235				
9.	U-238				
Soil geochemistry analysis					
1.	Aluminium(Al)	Sample from mining area/ore bodies		Quarterly	
2.	Arsenic (As)				
3.	Barium (Ba)				
4.	Berylium (Be)				
5.	Boron (B)				
6.	Calcium (C)				
7.	Chromium (Cr)				
8.	Cadmium (Cd)				
9.	Cobalt (Co)				
10.	Copper (Cu)				
11.	Cyanide (CN)				
12.	Iron (Fe)				
13.	Lead (Pb)				
14.	Magnesium (Mg)				
15.	Manganese (Mn)				
16.	Mercury (Hg)				
17.	Nickel (Ni)				
18.	Selenium (Se)				
20.	Tin (Sn)				
21.	Vandium (V)				
20.	Zinc (Zn)				

The main agenda of the compliance audit program is to verify that the on-site Management plan have been implemented effectively to attain the required level of environmental protection. To achieve this goal, two main mechanisms are employed, that is regular surveillance and evaluation of the required good environmental practices. These two strategies and their respective procedure of operation are as summarized in **Table 7-6**.

Table 7-6: Audit strategies and procedure

No.	Subjects	Notes
Surveillance of on-site practices		
1.	To verify on-site on the implementation of all proposed mitigation measures.	
2.	To ascertain the degree of compliance to the stipulated environmental requirements.	
Evaluation of on-site practices		
1.	To evaluate the performance of good environmental practices adopted on-site.	
2.	To employ quantifiable environmental conditions determined in the monitoring study.	
3.	To evaluate the implementation records pertaining to on-site practices.	
4.	To assess the adequacy of efforts towards maintaining the proposed mitigation measures at optimum efficiency.	

The above procedures would provide the basis for proposing improvement (if applicable) on the existing mitigating measures that have been ascertained as inadequate. These audit protocols would be employed to verify conformity to the audit criteria (i.e. compliance of the on-site practices to their respective environmental requirements) during both the construction and operational phases of development. There would be more emphasis on auditing the spectrum of project activities conducted during the construction phase.

The compliance program is to be conducted quarterly by the appointed environmental consultant upon the commencement of earthworks. The itinerary of items for inspection and verification includes all the stipulated on-site practices outlined within each management plan. Once the implementation of the mitigating feature has been validated, their efficiency in mitigating against the negative impacts associated with project development would be evaluated. A wider scope of area is adopted in the audit procedure, since some of the identified impacts may significantly extend beyond the project site boundary.

7.4.4 Mine sustainability audit

Mine sustainability audit is one of the mine auditing programs with the main objective to ensure Sustainable Development concept is truly implemented at the mine. It is proposed that Sustainable Development Indicator (SDI) auditing format, as designed by JMG and attached in **Appendix 7-1,** shall be used for the sustainability audit. Conducted by an appointed consultant and as a norm, a yearly audit cycle during the entire life of the mine is proposed.

SDI for mining with a specific focus on SD principles are organized into the NR-REE mining life cycle framework that includes (1) exploration, (2) mining, (3) processing, (4) mine closure and (5) rehabilitation. The SDI auditing should focus on the checklist and process including detailed scope of appropriate auditing activities to be undertaken as specified in the SDI audit form. The audit outputs should be collaborated with the status of SDI on mining and processing of NR-REE as elaborated in **Appendix 7-2.**

7.5 ENVIRONMENTAL CONTINGENCY PLAN AND EMERGENCY RESPONSE PLAN

Environmental Contingency Plan (ECP) describes the potential of environmental related incidents and emergency situations, communication and response/combat systems, synergy with local entities and communities, including structure, human and material resources. The main aim of the ECP is to assist in effectively coordinating resources, to contain and minimize any potentially detrimental effect on the surrounding environment, health and well-being of employees, and/or the general public, as a result of unexpected or unintended incidents. The objectives of the ECP are summarised in **Table 7-7**.

Table 7-7: Provisions of the ECP and ERP

No.	Subjects	Notes
ECP		
1.	To allocate resources (manpower and containment facilities) to enable timely and efficient response to emergency situations.	
2.	To institute measures to minimize impacts inclusive of risk to workers, public and the environment as a result of such emergency situations.	
3.	To explore measures to prevent the occurrence and reoccurrence of such emergency	
ERP		
1.	Implementation plan based on personnel safety.	
2.	Evacuation plan and posting in all major corridors.	
3.	Notification plan, complete with employees alarm method and list of emergency contacts.	

Table 7-7: Provisions of the ECP and ERP (Continued)

No.	Subjects	Notes
4.	Response plan defining the matrix utilize to arrive at the appropriate response level.	
5.	Documentation plan identifying forms and information about hazardous material in the facility.	
6.	Emergency Response Team (ERT) plan, which would consist of personnel within the facility, complete with their respective roles and guidelines in case of an emergency.	
7.	Mobilization plans, which would include equipment, material, and services required for the implementation of response to an emergency event.	
Emergency response team		
1.	To form an emergency response team which consists of emergency commander, assisted by emergency coordinator.	
2.	Emergency commander shall overall in-charge during emergency.	
3.	Emergency coordinator shall coordinate with first line response team, first aider and other agencies such as fire brigade (BOMBA), hospital and police.	
4.	To classify emergency incident, which will facilitate in decision making of the type and level of action to be taken.	
5.	To set-up an effective communication network between the mine management and the neighbouring communities and local authorities to ensure emergency response is efficient.	

The purpose of the Emergency Response Plan (ERP) is to establish a process to respond to emergency cases during the mining operation. The application of ERP is basically to effect a prevention and cure program aimed at controlling the advent of abnormal plant and operational incidences, and to mitigate such incidences if they occur. The successful administration and implementation of safety measures and ERPs requires a systematic approach including the organization, management and training of a special taskforce to carry out specific duties and responsibilities. This ERP would include, but not limited to as stated in **Table 7-7**.

7.6 FINANCIAL COMMITMENT AND BUDGET

The Project Proponent shall be committed to provide financial allocation for the purpose of implementing the Environmental Management Plan and Environmental Monitoring of the project. Further incoming budget shall be based on the requirement and condition, according to changes under any circumstances and need, when necessary.

MINE REHABILITATION PLAN

8.0

8.1 INTRODUCTION

Mining is an activity of temporary land use that will eventually close down as a result of reserve depletion or due to various technical, financial or legal complications. The mine's planned closure is normally possible when economic mineral resources are depleted and, in such cases, planned closures of mines with satisfactory rehabilitation are possible. Sometimes, unplanned closures may result in unsatisfactory rehabilitation of mine sites.

In line with the concept of mining for closure, the key objectives of rehabilitation of mines during operations, are that progressive rehabilitation and later, after their closures are to achieve the followings:

- ✧ Ensure the long-term stability and sustainability of the final landforms, soils and hydrology of the site.
- ✧ Prevent pollution to the surrounding areas including to ensure that water leaving mining lands meets statutory standards.
- ✧ Ensure that rehabilitated lands are transformed into sustainable and preferably economic land use.

8.2 STATUTORY REQUIREMENTS

NR-REE mining development and operation is a large scale operation as defined under Section 2(1) Mineral (Perak) Enactment 2003. Thus, it is under the purview of the rehabilitation requirements under Section 126 that is rehabilitation plan for mining lease authorizing large scale operation. The right to mine for the holder of ML/PML is contingent on obtaining approval of mine rehabilitation plan, as prescribed in Section 64(1)(b), Mineral (Perak) Enactment 2003 for large scale mining, as stated in Section 126.

Section 126(2) stipulates that the mine rehabilitation plan shall provide for specific rehabilitation actions, inspections, annual reports, estimated total cost for rehabilitation, cost estimates for each specific rehabilitation action and a detailed timetable for the orderly and efficient rehabilitation of the mining land. Other than the commitment as imposed under Section 126, there are many other obligations on the part of the ML/PML

to observe, pertaining to the requirement of mine rehabilitation. The overall obligations on the part of ML/PML holders are listed in **Table 8-1**.

Table 8-1: Obligations of ML/PML holder towards mine rehabilitation

No.	Obligations	Notes
Mineral (Perak) Enactment 2003 (Derived)		
1.	Section 126 – The right to mine of the holder of ML/PML is contingent on obtaining approval of mine rehabilitation plan as prescribed in Section 64(1)(b).	
2.	Section 126 – The mine rehabilitation plan, shall provide the followings: ✧ Specific rehabilitation actions. ✧ Inspections. ✧ Annual reports. ✧ Estimated total cost for rehabilitation. ✧ Cost estimates for each specific rehabilitation action. ✧ A detailed timetable for the orderly and efficient rehabilitation of the mining land.	
Mineral Development Act 1994		
1.	Regulation 3(1)(s) of the Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 – The submission of OMS under Section 10(1) Mineral Development Act 1994 to include information on the proposed progressive rehabilitation and post mine closure plans.	
2.	Section 20(1) – To give 3 months written notice to JMG before any mining operations is abandoned or discontinued.	
3.	Section 20(2) – To provide to JMG an accurate plan showing the workings of such mine up to the time of abandonment.	
4.	Section 20(3) – To securely fence or cover every mine shaft or adit of abandoned mines to the satisfaction of JMG.	
5.	Section 20(4) – To make safe the abandoned mines and waste in such manner as may be prescribed.	
Environmental Quality Act 1974		
1.	Section 34A(3) – To comply with COAs of the EIA for the project.	

Where there is a legal requirement to undertake rehabilitation, the ML/PML holder is the party responsible for rehabilitating the mine. The competent person to prepare the rehabilitation plan is a professional engineer with practicing certificate in the discipline of Mining or Mineral Resource Engineering, registered with the Board of Engineers Malaysia.

Other than a statutory requirement for submission and approval of rehabilitation plan as stipulated in Section 126, Mineral (Perak) Enactment 2003, ML holder authorised for large

scale operation and subject to conditions as prescribed in Section 127(3) is required to pay into the mine rehabilitation fund.

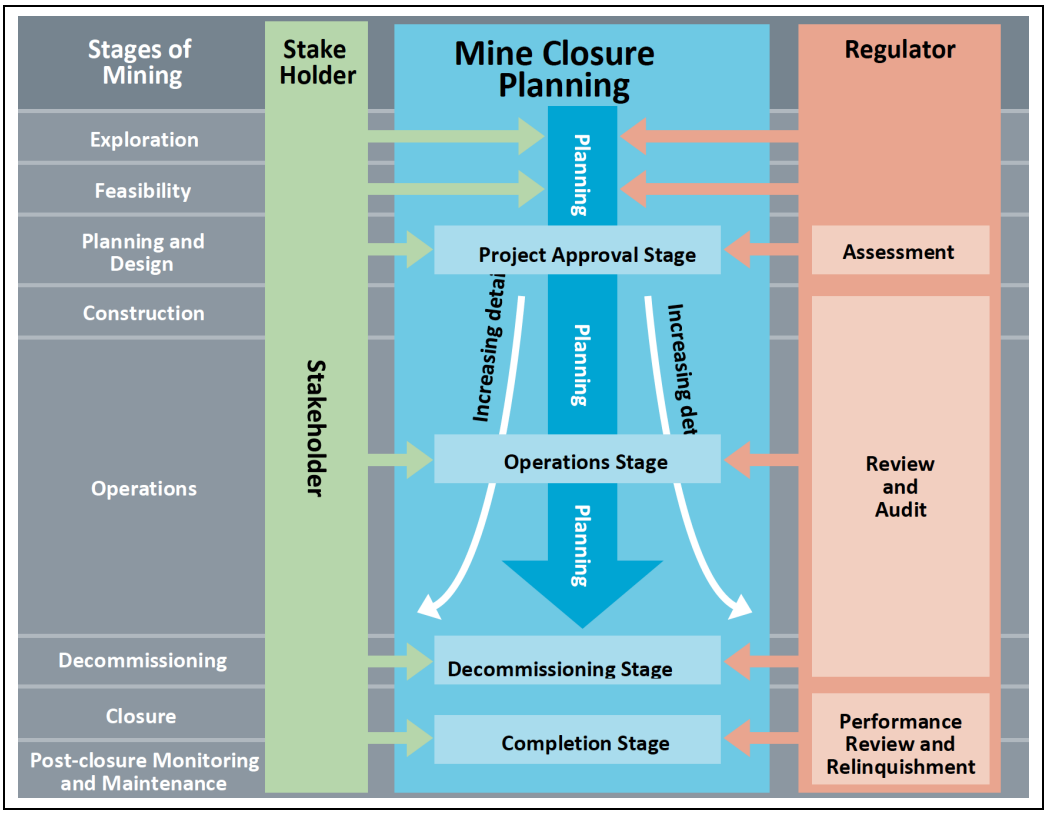
8.3 MINE REHABILITATION PLANNING

The rehabilitation plan is expected to be straight forward as there will be minimum land clearing for the proposed project. Nevertheless, an elaborate post-operation rehabilitation plan is necessary, particularly on the cleaning of the residue chemicals in the injection holes and soils of each ISL mining area.

Rehabilitation planning must start at the mine feasibility study stage and should be periodically reviewed over the life of the mine, because of possible changes to the life of mine plan, and also to make refinements to the rehabilitation plan. The objectives of rehabilitation planning are presented in **Table 8-2** with the stages of rehabilitation planning (mine closure planning) over the life of a mine is depicted in **Figure 8-1.**

Table 8-2: Objectives of mine rehabilitation planning

No.	Objectives	Notes
1.	To collect, at and around the mine site, environment baseline data including rainfall, water quality of rivers, flora and fauna, and geochemical characteristics of rocks/soils at ground surface as well as social baseline data including on houses, buildings, and existing inhabitants. The data will be used as comparison to similar data of the future rehabilitated land-use sites.	
2.	To understand the characteristics of rocks/soils to be affected at the mine and advantageous features or constraints of the site to enable proper planning of mine waste management to be undertaken.	
3.	Select the suitable land-use/uses of the site after mine closure based on the ISL mining method employed and characteristics of rocks/soils affected by the mining operation.	
4.	To develop a rehabilitation plan that is consistent with the operational life of mine plan, which in the case of a new mining project is the Mine Feasibility Study plan, so as to enable the selection of suitable land-use/uses of mined-out lands.	
5.	To estimate the cost of the rehabilitation plan and its impact on the financial viability of the mining project. Economic considerations may make it necessary for several repetitive trial life of mine plans, and rehabilitation plans to be undertaken before both plans are adopted at the Mine Feasibility Study stage.	



Source: Department of Mines and Petroleum Environmental Protection (2015)

Figure 8-1: Rehabilitation planning over life of mine

8.3.1 Land-use planning

Selection of land-use after mine closure is a vital input to life of mine planning and rehabilitation planning. The land-use selected after mine closure will be determined mainly by the existing land-use of the site and its surrounding areas, type of mining method employed and its resultant landforms after completion of mining, and size of the mine as well as the proximity of the mine to centre of population.

8.3.2 Progressive rehabilitation

All disturbed areas that are no longer required for mining purposes, have to be rehabilitated as early as possible, at least within twelve (12) months with reference to the approved proposal so as to achieve benefits of progressive rehabilitation as listed in **Table 8-3**.

Table 8-3: Benefits of progressive rehabilitation

No.	Benefits	Notes
1.	Shall reduce the acreage of disturbed land to be rehabilitated in the event of an unplanned mine closure.	
2.	Shall reduce the acreage of un-vegetated disturbed land so as to reduce the potential of soil erosion.	
3.	Shall enable various planned rehabilitation techniques to be tested, if necessary, to improve and thereby ensuring successful rehabilitation after mine closure.	
4.	To reduce the cost for mine closure, the liability to shut down a mine at various stages of the mine life, for cases with and without progressive rehabilitation, as the cost liability is less with progressive rehabilitation.	

8.3.3 Land restoration

When the REE recovery in the pregnant solution collected is less than 0.1%, the clear water injection will commence and this “wash out” process will stop when the AN level in the leachate collection is below the regulated level. After the removal of the pipeline network and other project components and equipment, backfilling and land levelling will be conducted and surface vegetation will be restored, before the land is delivered back to the respective beneficiaries.

It is estimated that the land restoration time will take about a year after completion of the mining operation. Land restoration mainly takes three measures into consideration which comprises of land stabilization, soil improvement and vegetation restoration with the scope details presented in **Table 8-4**.

Table 8-4: Main components of land restoration

No.	Main components	Notes
Land stabilization		
1.	To stabilize post leaching soil structure conditions to improve soil cohesion and avoid debris flow and risk of landslide.	
2.	To utilise stabilization engineering treatment to be carried, if deem necessary before vegetation restoration.	
3.	To utilise the extracted soil during the establishment of the liquid injection hole to backfill the injection hole after the leaching process is completed.	
4.	To demolish and appropriately disposed the hydrometallurgy plant and to level out the site.	

Table 8-4: Main components of land restoration (Continued)

No.	Main components	Notes
5.	To remedy slope stability, eroded area filled up and compacted. Sections with potential landslide hazards shall be strengthened and supported, with retaining piles set at the foot of the hazard area to block potential landslide.	
6.	To maintain the natural drainage system of the original topography as much as possible so as to achieve good drainage and minimum surface runoff of the site.	
7.	To improve the drainage system to ensure the integrity of the drainage system at site.	
8.	To carry out monitoring on surface water and groundwater throughout the land stabilization period to monitor the potential impacts and changes to the surrounding water body.	
Soil improvement		
1.	To improve the soil at site according to their characteristics where soil improvement in soil nutrients will directly affect the degree and speed of vegetation restoration.	
2.	To balance the proportion of N, P and K in the soil which might have been affected by the ammonium sulphate solution used in the leaching process.	
3.	To remove the excessive ammonium ions that remain in the soil by carrying out clear water flushing after completion of ISL mining.	
4.	To engage specific soil treatment measures which shall be formulated according to the condition of soil nutrient at the time of the development of rehabilitation plan.	
Vegetation restoration		
1.	To utilise phytoremediation, using living green plants for in-situ removal, degradation, and containment of contaminants in soils, surface waters, and groundwater to stabilize and strengthen the land while restoring the soil.	
2.	To utilise phytoremediation in preventing secondary pollution of groundwater and the surrounding environment, during the rehabilitation process, and will not cause damage to the soil structure.	
3.	To select local native plant species as much as possible, which adapts to the local ecological environment and avoids the invasion of foreign organisms and reduces the disturbance to the surrounding community structure.	
4.	To select perennial grass irrigation with fast growth and strong germination at the initial stage of treatment, for areas with rapid soil and water erosion.	
5.	To select plants with nitrogen fixation ability to improve soil fertility	

MINE AND PLANT SAFETY MANAGEMENT 9.0

9.1 INTRODUCTION

Safety is one of the dimensions of sustainable mining practices, along with the other important dimensions of economy, environment, community, and efficiency. Three of these dimensions; economy, environment, and community, represent the pillars of sustainable development. In mining, it is also important to consider safety and efficiency. Efficiency relates directly to the resource and encompasses optimization, technical competency, and sustaining the resource. Mining is a high-risk industry with operating hazards that can have serious health and safety consequences. Those primarily at risk are mine workers, but some mining hazards can also present health and safety risks to people living in the vicinity of the mining lease. Safety in the mining industry must encompass the full cycle of exploration, development, construction, operations, rehabilitation, and mine closure.

9.2 STATUTORY REQUIREMENTS

The health and safety of all people on the mineral tenements are governed by the Mineral Development Act 1994, Factory and Machinery Act 1967 and the Occupational Safety and Health 1994. Mineral Development Act 1994 emphasises the importance of occupational safety and health in a mine, as reflected in Section 10(4). An OMS can only be approved if the workplace is reasonably safe and would not endanger the adjoining community. Mineral Development (Safety in Exploration and Surface Mining) Regulations 2014 has been enacted to emphasise on the responsibility of the mine operator to provide a safety management plan to address risk control, safety and emergency at the exploration and at the mine area.

Occupational Safety and Health Act 1994 is supported by regulations, codes of practices and guidelines to further clarify the provisions in the Act. Under the Factories and Machinery Act 1967, emphasis is primarily positioned on safety while with Occupational Safety and Health Act 1994, it is arguably been equal emphasis on addressing health hazards in the workplace. Regulations for occupational exposures are developed by the

JKKP after consultation with interested parties consisting of workers, employers and authorities.

The statutory requirements related to safety in various laws and regulations which shall be complied by mine operator listed in Table 9-1.

Table 9-1: Laws and regulations related to safety of mining operation

No.	Provisions	Notes
Mineral Development Act 1994 (Derived)		
1.	Section 10(4)(i) – OMS may only be approved if it will provide a reasonably safe workplace.	
2.	Section 10(4)(i) – OMS may only be approved if it will not endanger adjoining communities.	
3.	Section 13 – Good and safe practices and environmental standards.	
4.	Section 14(11) – Duty of mine manager to ensure the safety of all operations at the mine and the observance of the provisions of the Act.	
5.	Section 15(1) – Direction for mine manager related to occupational safety and health of the mine workers.	
6.	Section 20(4) – Abandoned mines and waste retention areas shall be made safe in such manner as may be prescribed.	
7.	Section 23(c)(ii) – A mine officer may investigate in respect of any fossicking, panning, exploration or storage facility area or mine or mineral processing plant concerning any accident or dangerous occurrence.	
8.	Section 23(c)(iii) – A mine officer may investigate in respect of any fossicking, panning, exploration or storage facility area or mine or mineral processing plant concerning any matter related to the safety or health of any person likely to cause damage to property or is a nuisance.	
Mineral Development (Safety in Exploration and Surface Mining) Regulations 2014 (Derived)		
1.	Regulation 3(1) – Holder of licence shall prepare and submit a safety management plan to Assistant Director of Mine (JMG) for approval within six (6) months of the start of any development work in a mine or three (3) months of the start of exploration.	
2.	Regulation 3(2) – Safety management plan shall be prepared by a consultant who shall be a mining or mineral resource engineer registered with the Board of Engineers Malaysia.	
3.	Regulation 3(3)(a) – Safety management plan shall consist of identification of hazardous areas, substances and activities and an assessment of the degree of risks arising from the hazards.	

Table 9-1: Laws and regulations related to safety of mining operation (Continued)

No.	Provisions	Notes
4.	Regulation 5(1) – Holder of the licence shall take all necessary measures to eliminate or minimize the risks to safety in a workplace.	
Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 (Derived)		
1.	Regulation 3(1)(r) – An operational mining scheme shall consist of information on safety procedures during development work.	
2.	Regulation 5(e) – The mine manager shall maintain record books consisting of details on a mine safety inspection.	
Occupational Safety and Health Act 1994 (Derived)		
1.	Section 15 – General Duties of Employers and Self-Employed Persons: ✧ To provide and maintain a plant and safe system of work. ✧ To make arrangements to ensure safe use, handling and storage of plants and substances. ✧ To provide information, instruction, training and supervision. ✧ To maintain safe access and aggress to work area.	
	✧ To maintain a working environment of the workplace.	
2.	Section 16 – Duty to formulate safety and health policy.	
3.	Section 20 – General duties of manufacturers as regards plant for use at work: ✧ The plant is designed to be safe for use. ✧ To carry out testing and examination. ✧ Provide information on the plant.	
4.	Section 21 – General duties of manufacturers as regards substance for use at work: ✧ The substances is designed to be safe for use, ✧ To carry out testing and examination. ✧ Provide information on the substances.	
5.	Section 24 – General duties of employees: ✧ To take care of his and other safety and health. ✧ To co-operate with the employer to discharge duty. ✧ To wear protective equipment. ✧ To comply with the instruction of the employer.	
6.	Section 30 – Establishment of a safety and health committee at the workplace is required if there is more than 40 person employed at place of work or if the Director-General directs the establishment to have such committee.	

Table 9-1: Laws and regulations related to safety of mining operation (Continued)

No.	Provisions	Notes
7.	Section 31– The main function of a safety and health committee: ✧ To review measures taken to ensure the safety and health of persons at the place of work. ✧ To investigate matters that are not safe and risk to health. ✧ The safety and health committee has a specific regulation under the OSH Act 1994 which is the Occupational Safety and Health (Safety and Health Committee) Regulations 1996.	
8.	✧ Section 32(1) – Notification of accidents, dangerous occurrence occupational poisoning and occupational diseases, and inquiry. An employer shall notify the nearest occupational safety and health office of any accident, dangerous occurrence, occupational poisoning or occupational disease which has occurred or is likely to occur at the place of work.	
Factory and Machinery Act 1967 (Derived)		
1.	Section 19 – Certificate of fitness: ✧ For mines which use machinery which required Certificate of Fitness (CF) like an air compressor and hoisting machine still requires to register using Form JKJ105. ✧ For the installation of general machinery such as conveyor, permission to install is still a requirement using Form JKJ112 for submission to DG JKKP.	
2.	Section 34(2)(a) – ✧ Notification pertaining to the first occupancy of the factory. ✧ All mines which are within the definition of factory as defined under Section 2, Factory and Machinery Act 1967 should submit information as prescribed in Form JKJ 101 to the DG JKKP. ✧ If mine is not within the definition of a factory, mining activity still need to be registered through MyKKP System. Application should be submitted online via MyKKP to JKKP.	
3.	Section 37(1) – Application for registration. ✧ Every person who comes into possession of any machinery in respect of which a certificate of fitness is prescribed, shall send to the Inspector and licensed person such particulars in such manner as may be prescribed. ✧ Application for the registration of factory, Installation of Machinery Permission and the Registration of Certified Machinery.	

9.3 MINE SAFETY MANAGEMENT PLAN

As stipulated under Section 12(1), Mineral Development Act 1994, it is mandatory for the holder of an ML/PML to comply with the approved OMS under section 10 in its operation. Regulation 3(1)(r), Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 provides that an OMS shall consist of information on safety procedures during development work as provided under Regulation 3 and Regulation 5, Mineral Development (Safety in Exploration and Surface Mining) Regulations 2014. The Mine Safety Management Plan shall cover information as listed in **Table 9-2** with technical information of relevance elaborated in **Table 9-3**.

Table 9-2: Scope of the mine safety management plan

No.	Subjects	Notes
Mineral Development (Safety in Exploration and Surface Mining) Regulations 2014 (Derived)		
1.	Identification of area, harmful material and activities, and risk level assessment which might arise from that harmful activity.	
2.	Steps to reduce risk control.	
3.	Program on safety training.	
4.	Safety procedure and report submission in the event of accident.	
5.	Emergency Response Plan (ERP). ✧ Measure for ensuring safety and stability of mine faces etc. ✧ The provision of appropriate safety facilities, equipment and warning system.	
	✧ The formation of mine rescue team. ✧ The manner of informing the relevant authorities in the event of any emergency.	
6.	Such other particulars as may be required in writing by the Assistant Director of Mine (JMG).	

Table 9-3: Components of Safety Management Plan

No.	Subjects	Notes
Occupational Safety and Health Act 1994, Factory and Machinery Act 1967 (Derived)		
Risk management		
1.	Preparation and maintenance of plant and safe system of work which should not generate risk to health.	
2.	Management to ensure safety and no health risk in the use or operation, plant storage and material.	
3.	Make available safe method of access in and out.	
4.	Make available and maintenance safe working environment with adequate facility on the workers welfare at the workplace. In addition, the employer should carry out risk assessment to assess	

Table 9-3: Components of Safety Management Plan (Continued)

No.	Subjects	Notes
	hazard and to analyse the relevant risk, where it will show the risk level (low / medium / high) for a certain identified hazard, and provide a method for the relevant risk control with reference to Guidelines for Hazard identification, Risk Assessment and Risk Control (HIRARC).	
5.	Mine workers at Ion-adsorption ISL mining operation are exposed to chemical which may cause occupational disease to the workers. Risk assessment on the health of the workers need to be conducted by Chemical Risk Assessor, registered with Director General (JKKP) as provided under the Occupational Safety and Health (Use and Standard of Exposure Chemical Hazardous to Health) Regulations 2000.	
Safety management		
1.	Responsibility for every worker while working to observe all procedures which have been established and wear all PPE which have been provided by the employer.	
2.	Employers are encouraged to employ a dedicated person to act as Safety and Health Officer for all mining activities or a person in charge on occupational safety and health for all mining activities as mining activities are high risk activities.	
3.	To impose stop-work order to the contractor and workers for non-compliance which may compromise safety risks.	
4.	Every employer must establish a Committee on Safety and Health (JKK) at the workplace as required under Section 30, OSHA 1994 if the number of workers are 40 or more, or under the directive of the Director-General (JKKP). JKK is a platform between employer/worker/vendor/sub-vendor to discuss on issues related to occupational safety and health and identify possible solutions.	
5.	In a case of accident or dangerous incident, the employer should inform the JKKP office as soon as possible and submit the Accident Report Form (JKKP6) as provided under Section 32, OSHA 1994.	
Regulatory requirements		
1.	Application for the registration of factory, installation of Machinery Permission and the Registration of Certified Machinery.	
2.	All mines to ensure that the workplace and the machinery have been registered in compliance with the requirement of FMA 1967 and the mining operation shall not endanger the safety of the workers and the publics.	
3.	All mines which are within the definition of the factory as defined under Section 2, Factory and Machinery Act 1967 should submit information as prescribed in Form JKJ 101 to the Director General (JKKP), that is a notification pertaining to the first occupancy of the	

Table 9-3: Components of Safety Management Plan (Continued)

No.	Subjects	Notes
3.	factory as required under Section 34(2)(a), Factory and Machinery Act 1967.	
4.	If mine is not within the definition of a factory, mining activity still needs to be registered through MyKKP System. Application should be submitted online via MyKKP to JKKP.	
5.	For mines which use machinery which required Certificate of Fitness (CF) like air compressor and hoisting machine still require to register using Form JKJ105. As for the installation of general machinery such as crusher and conveyor, permission to install is still a requirement using Form JKJ112 for submission to Director General (JKKP).	
Safety training program		
1.	To ensure that all workers must undergo basic training program before the commencement of employment.	
2.	To provide a safety training program which includes basic training and revision, covering the introduction to safety management plan, specific training to mining methods and introduction to workers right and responsibility.	
3.	To provide specific training program for mine rescue team.	
4.	To appoint competent person to conduct training program on safety and training record safe keeping.	

PART 3
MINING OPERATION

MINE DEVELOPMENT AND OPERATION MANAGEMENT

10.0

10.1 INTRODUCTION

Mine development and operation, including mineral processing, may only commence upon completing all the regulatory processes and procedures prescribed in various relevant laws and regulations. The main governing law pertaining to a mining operation in Malaysia is the Mineral Development Act 1994. Its Regulations and Guidelines are dedicated for specific subject areas, ranging from exploration, safety, and mine rehabilitation. JMG is the leading authority in the enforcement of various provisions in the Act and is effectively the main authority facilitating the approval processes of the statutory requirements.

10.2 STATUTORY REQUIREMENTS

Various statutory requirements which need to be complied, before the mine development and operation may be allowed to commence, have been elaborated in earlier chapters. The previous **Figure 1-2** summarized the flowchart of the process, where each approval given is subjected to COAs, which need to be complied and implemented throughout the mine life. The COAs shall be part of the controlling mechanism in the project implementation stage. **Table 10-1** presents a list of post approval obligations and parties that shall be responsible in ensuring compliances, particularly on the approval conditions.

Table 10-1: Post approval, obligation, compliance and responsibility

Approval/Action	Governing laws and regulations	Compliances	
		Obligation	Responsibility
Pre-Operation			
PL/EL	✧ EL – Section 41, Mineral (Perak) Enactment 2003 ✧ PL – Section 48(1), Mineral (Perak) Enactment 2003	✧ COAs ✧ Fieldwork ✧ Reporting	✧ PL/EL Holder

Table 10-1: Post approval, obligation, compliance and responsibility (Continued)

Approval/Action	Governing laws and regulations	Compliances	
		Obligation	Responsibility
Field Exploration	✧ Section 41(7)(a) Mineral (Perak) Enactment 2003 ✧ Section 42(1)(a) of the Mineral (Perak) Enactment 2003 ✧ Regulation 3(1), Mineral Development (Safety in Exploration and Surface Mining) Regulations 2014	✧ COAs ✧ Fieldwork ✧ Reporting	✧ PL/EL Holder
ML/PML	✧ ML - Section 63, Mineral (Perak) Enactment 2003 ✧ PML - Section 81, Mineral (Perak) Enactment 2003	✧ COAs ✧ Payments of Fees	✧ PL/EL Holder
EIA	✧ Section 34A, Environmental Quality Act 1974 ✧ EIA Oder 2015	✧ COAs ✧ EMP	✧ Project Proponent
Planning Permission (KM)	✧ Section 19, Town and Country Planning Act 1976	✧ COAs ✧ KM	✧ Project Proponent
Social Impact Assessment (SIA)	✧ Development projects (Category 3) other than specified under Sections 20B(1), 20B(2), 22(2A), Town and Country Planning Act (Amendment) 2017	✧ COAs ✧ KM	✧ Project Proponent
Operation			
OMS	✧ Section 10(1), Mineral Development Act 1994 ✧ Regulation 3(1), Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007	✧ COAs ✧ Fieldwork ✧ Reporting	✧ ML/PML Holder ✧ Mine Manager
EMP	✧ Section 34A, Environmental Quality Act 1974	✧ COAs ✧ Fieldwork ✧ Monitoring ✧ Reporting	✧ Project Proponent ✧ Environmental Officer
ESCP/LDP2M2	✧ Section 34A, Environmental Quality Act 1974	✧ COAs ✧ Fieldwork ✧ Monitoring ✧ Reporting	✧ Project Proponent ✧ Environmental Officer

Table 10-1: Post approval, obligation, compliance and responsibility (Continued)

Approval/Action	Governing laws and regulations	Compliances	
		Obligation	Responsibility
Mine rehabilitation plan (Notes: Mine rehabilitation plan must be submitted prior to OMS approval. This particular inclusion is a continuous)	✧ Section 64 and Section 126, Mineral (Perak) Enactment 2003, ✧ Regulation 3(1)(s), Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007	✧ COAs ✧ Fieldwork ✧ Monitoring ✧ Reporting	✧ ML/PML Holder ✧ Mine Manager ✧ Project Proponent
Mine safety management	✧ Section 10, Mineral Development Act 1994 ✧ Mineral Development (Safety in Exploration and Surface Mining) Regulations 2014 ✧ Regulation 3(1)(s) Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 ✧ Factory and Machinery Act 1967 ✧ Occupational Safety and Health 1994	Mine Safety Management	✧ ML/PML Holder ✧ Mine Manager
Mining operation and processing	✧ Sections 10, 12, 13, 14 and Section 15 Mineral Development Act 1994 ✧ Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 ✧ Section 34A, Environmental Quality Act 1974	Operation	✧ ML/PML Holder ✧ Mine Manager
Statistical monthly return	✧ Section 2, Mineral Development (Statistical Return) Regulations 2019	Operation	✧ ML/PML Holder ✧ Mine Manager

Table 10-1: Post approval, obligation, compliance and responsibility (Continued)

Approval/Action	Governing laws and regulations	Compliances	
		Obligation	Responsibility
Post mining operation			
Mine closure plan	✧ Section 20, Mineral Development Act 1994	Abandonment Plan	✧ ML/PML Holder ✧ Mine Manager ✧ Project Proponent

10.3 STATUTORY RESPONSIBILITIES OF ML/PML HOLDER AND MINE MANAGER

The roles of the ML/PML holders and the appointed mine manager have been clearly expressed in various Sections of Mineral Development Act 1994, Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 and Mineral Development (Statistical Returns) Regulations 2019 as presented in **Table 10-2**.

Table 10-2: Statutory responsibilities of ML/PML holder and Mine Manager

No.	Provisions	Notes
Mineral Development Act 1994 (Derived)		
1.	Section 14(1)– The holder of a ML/PML shall appoint a manager, ✧ Where there are 10 or more persons employed at the mine; or ✧ The Assistant Director of Mine (JMG) has notified the holder that a manager is required.	
2.	Section 14(4)– The holder of a ML/PML may appoint such number of assistant managers as may be necessary to assist the manager, any such appointment shall be with the approval of the Assistant Director of Mine (JMG).	
3.	Section 14(7) – A manager appointed under subsection (1) shall be: ✧ Responsible for the control and daily supervision of the mine of which he has been appointed manager. ✧ Reside in close proximity to such mine unless exempted in writing by the Assistant Director of Mine (JMG).	
4.	Section 14(8) – Where a manager is required under this Act, no work shall be carried out at the mine unless: ✧ The requirements of this section have been complied with. ✧ The manager is supervising the working of the mine.	
5.	Section 14(9),– Where in any mine the workings extend over or are separated by such a distance that control and daily supervision by one manager is, in the opinion of the Assistant Director of Mine (JMG), inadequate, he may require that a manager be appointed to control and supervise such of those workings as he may specify,	

Table 10-2: Statutory responsibilities of ML/PML holder and Mine Manager (Continued)

No.	Provisions	Notes
	and thereupon a manager shall be appointed in accordance with this Act for the workings so specified.	
6.	Section 14(11) – The holder of a ML/PML and every manager, assistant manager and person appointed under subsection (10) shall ensure the safety of all operations at the mine and the observance of the provisions of this Act.	
7.	Section 15(1) – Direction for mine Manager related to occupational safety and health of the mine workers.	
8.	Section 16(1) – The manager of any mine shall keep at the office: ✧ Accurate plans of the workings of the mine made from actual survey, ✧ At intervals of not more than six (6) months, any additional working or extension made since the previous survey was affected shall be surveyed and delineated on the plans.	
9.	Section 16(5) – The manager shall make available such plans at the mine whenever requested by any mines officer and the manager shall, if so requested, mark on such plans the progress of the workings of the mine at the time of production, and shall allow the mines officer to examine and take a copy thereof.	
10.	Section 17(1) – Record books on operations. The manager of a mine shall keep record books, in such form and containing such information as may be prescribed, concerning the operation of the mine.	
11.	Section 19(2) – Erosion. Whenever directed by the Assistant Director of Mine (JMG), every holder of a mineral tenement and his manager shall provide and maintain such retention works or other places as necessary and adequate to prevent the products of erosion from being discharged into any river or drainage system.	
12.	A written notice shall be given three months before such intended abandonment or discontinuance by the holder of ML/PML or manager to the Assistant Director of Mine and to the Director General of Geological Survey.	
13.	Section 20(2) – Where any mine is to be abandoned, the holder of the ML/PML or manager shall cause to be made an accurate plan, to the satisfaction of the Director, showing the workings of such mine up to the time of abandonment and copies of such plan shall be submitted to the Director and the Director General of Geological Survey within one month after the abandonment.	
14.	Section 20(3) – Where a mine or part of a mine is to be abandoned, the holder of ML/PML or manager shall securely fence or cover every mine shaft or adit and the holder of such lease or licence and the manager shall continue to be personally responsible for the due compliance of this provision until the Director has confirmed in	

Table 10-2: Statutory responsibilities of ML/PML holder and Mine Manager (Continued)

No.	Provisions	Notes
	writing that the work has been properly executed, notwithstanding that the mine or part of the mine has been abandoned.	
15.	Section 20(4) – Abandoned mines and waste retention areas shall be made safe in such manner as may be prescribed.	
Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 (Derived)		
1.	Regulation 4(1), – The manager shall maintain accurate plans of the workings of the mine through actual survey, consisting details as follows: ✧ Surface layout. ✧ Separate drawings on the horizontal plane for each level showing all underground workings, including shafts, electrical and ventilation systems, tunnels, diamond drill hole, dams and bulkheads. ✧ Separate drawings on the vertical plane of all mine sections at suitable intervals and azimuths, showing all shafts, electrical and ventilation systems, tunnels, drifts, stopes and other mine workings in relation to the surface, including the location of any known watercourse or body of water.	
2.	Regulation 5– The Manager shall maintain record books consisting details as follows: ✧ Mine organizational structure. ✧ Metallurgical balance of the ore processing.	
	✧ Prospecting results. ✧ Geological information of the tenement. Geological information of the tenement. ✧ Mine safety inspection. ✧ Pollution control monitoring. ✧ Production and sales records. ✧ Hazardous materials and toxic chemicals. ✧ Vehicles. ✧ Accidents. ✧ Rehabilitation. ✧ Ore waste and overburden where applicable. ✧ Financial obligations towards the Federal and State Governments.	
Mineral Development (Safety in Exploration and Surface Mining) Regulations 2014 (Derived)		
1.	Regulation 3(1),– Holder of licence shall prepare and submit a safety management plan to Assistant Director of Mines (JMG) for approval within six (6) months of a start of any development work in a mine or three (3) months of the start of exploration.	

Table 10-2: Statutory responsibilities of ML/PML holder and Mine Manager (Continued)

No.	Provisions	Notes
Mineral Development (Statistical Returns) Regulations 2019 (Derived)		
1.	Regulation 2 – The holder of ML/PML or the manager shall submit a monthly statistical return to the Assistant Director of Mines (JMG) within ten (10) days after the end of every calendar month.	
2.	Regulation 3 – The monthly statistical return shall consist of the following information: ✧ The type of minerals, mineral ores and by-products of mining produced. ✧ The quantity of waste. ✧ The value, quantity and grade of minerals, mineral ores and by-products of mining sold. ✧ The purchaser of minerals, mineral ores and by-products of mining. ✧ The quantity of stock of minerals, mineral ores and by-products of mining. ✧ Royalty paid to the State Authority. ✧ The quantity of energy consumption. ✧ The quantity of utilization of workforce. ✧ The mine effluent monitoring results, where applicable.	

The position of a mine manager is appointed under Section 14(1) Mineral Development Act 1994. The position carries statutory responsibilities as defined his respective roles in Section 14(7) of the act. The Mine Manager is also responsible on the environmental management aspects of the mining operation as defined in the same act. **Table 10-3** present the roles and responsibilities of an Mine Manager.

Table 10-3: Roles and responsibilities of a Mine Manager

No.	Roles and responsibilities	Notes
Mineral Development Act 1994, Environmental Quality Act 1974 and Occupational Safety and Health Act 1994 (Derived)		
1.	Responsible for the control and daily supervision of the mine.	
2.	Reside in close proximity to the mine unless exempted in writing by the Assistant Director of Mines (JMG)	
3.	Supervising working of the mine.	
4.	Implementing and enforcing appropriate environmental, safety and health practices at the project work area.	
5.	Ensuring that all planning on-site considers the safety of personnel and the protection of the environment.	
6.	To ensure compliance with applicable regulations, as outlined in the final approved EMP.	

Table 10-3: Roles and responsibilities of a Mine Manager

No.	Roles and responsibilities	Notes
7.	Coordinating and implementing the environmental control measures as detailed in the final approved EMP.	
8.	Assigning on-site environmental personnel to oversee implementation of the mitigation measures and ensure compliance with environmental requirements.	
9.	Overseeing the environmental monitoring programs.	
10.	Liaising with the relevant government departments as required.	
11.	Seeking the advice of the EMP Consultant regarding any environmental issues of concern.	

FINAL NR-REE MINE PRODUCTS, STORAGE, TRANSPORTATION, ROYALTY AND EXPORT

11.0

11.1 INTRODUCTION

The final mine product covered in this SOP is REC. The maximum production capacity per unit of hydrometallurgical plant is estimated at about 500 TPM or about 6,000 TPA. REC is discharged from the filter press in the form of cake with moisture contents in the range of 11% and stored at dedicated product storage stores. With such quantity of production, storage and transportation are unlikely to be issues of concern.

11.2 FINAL NR-REE MINE PRODUCTS

As elaborated in **Appendix 1-1**, the NR-REE production chain is complex and often involves a number of stakeholders, which can be divided into mining, mineral processing, cracking, and REE separation. The final product of the ISL mining of the RE IAC deposits under review is RE carbonate. This is the final mine product of any such ISL mining operation. Further processing to the next upgrade, that is REO and further refinements shall be carried out elsewhere. The technology for cracking and REE separation processes of ion-adsorption REC is currently only available in China. In contrast, the basic cracking for REE separation processes for mineral type RE concentrates, such as that in Lynas operating in Pahang is available worldwide. The cracking and REE separation processes of mineral type RE concentrates in Lynas are of different technology and cannot be used to process ion-adsorption RE carbonates. Thus, in future to further process the REC produced by the proposed ISL mining operation in Malaysia, R&D needs to be undertaken to develop suitable technology to be used locally. At present due to the limitations of local technology and complexity of the RE deposits, further processing need to be done elsewhere. Transfer of technology must be made in the near future to overcome these constraints.

The Government of Malaysia encourages related industries to acquire such strategic technologies, so that it can establish a full-fledged cracking and REE separation facility for the ion-adsorption RE concentrates in the country. In the future, a centralised NR-REE processing plant capable cracking, separating and refining NR-REE should be established. The REC produced by each mine in the country may then be upgraded into REO and further processing into individual RE elements.

11.3 PRODUCT STORAGE AND TRANSPORTATION

REC is defined as high value concentrate with an average per unit production capacity of approximately 500 TPM. It is not alike bauxite or rock aggregates (relatively low value and high volume) where stockpiling and transportation are issues of concern. Thus, storage and transportation matters in this case, is not complicated.

11.3.1 Statutory requirements

The relevant laws related to the handling, storage and transportation of mineral is govern within the Mineral Development (Licensing) Regulations 2017. Nevertheless, most of the provisions are not directly relevant to operating mines on ML/PML with valid OMS under Section 10, Mineral Development Act 1994. Under certain circumstances, involving transit storage and transportation of REC, certain relevant provisions of the Mineral Development (Licensing) Regulations 2016 are applicable. **Table 11-1** presents the relevant provisions of the regulations with respect to the transit storage and transportation of REC under this SOP.

Table 11-1: Provisions under Mineral Development (Licensing) Regulations 2016 on transit storage and transportation of REC

No.	Provisions	Notes
Mineral Development (Licensing) Regulations 2016 (Derived)		
1.	Regulation 5(1), Mineral Development (Licensing) Regulations 2016 – No person shall possess, purchase, sell, store, process or transport any minerals obtained from any source except from a holder of a valid mineral licence, a holder of a valid mineral processing licence, a holder of a valid mineral tenement or a valid mineral importer.	
2.	Regulation 6(1), Mineral Development (Licensing) Regulations 2016 – Prescribed activities requiring licence in handling of minerals with Sub-Regulation 6(1)(c) specifies on transportation where no person shall transport any mineral unless the person holds a licence to transport the said mineral subject to the rights of the holder of any mineral tenement provided under any written law.	
3.	Regulation 3, Mineral Development (Licensing) Regulations 2016 – it is a requirement for a storage management plan to be prepared: ✧ Storage management plan to be certified by a consultant which contains a layout plan and details of the mineral storage area. ✧ Information in relation to safety measures at the time of mineral handling. ✧ Information in relation to the environmental protection measures including the information in relation to pollution control and	

Table 11-1: Provisions under Mineral Development (Licensing) Regulations 2016 on transit storage and transportation of REC (Continued)

No.	Provisions	Notes
3.	✧ mitigation, monitoring plans and contingency plans, where applicable. ✧ Maintenance of operation records. ✧ Information in relation to the handling of solid waste, effluent discharge or gas emission. ✧ A post closure plan of the mineral storage activities, where applicable.	

11.3.2 Storage and transportation

REC shall be stored and transported in flexible intermediate bulk containers (FIBC bags) or jumbo bags. These jumbo bags as shown typically in **Figure 11-1** are heavy-duty, most popular style being the 'spout bags', which is made of a durable, high-quality polypropylene fabric. They can be recycled and reused. FIBC bags is great for warehouse integration at the mine and within the shipping facility at the port. They work well with forklifts and palletizers.

The product shall be securely stacked in containers for export, transported from the product storage warehouse within the mine site to the nearest port by suitable fully covered trucks. The jumbo bag stacking arrangement during storage and transportation is as shown in **Figure 11-2**.

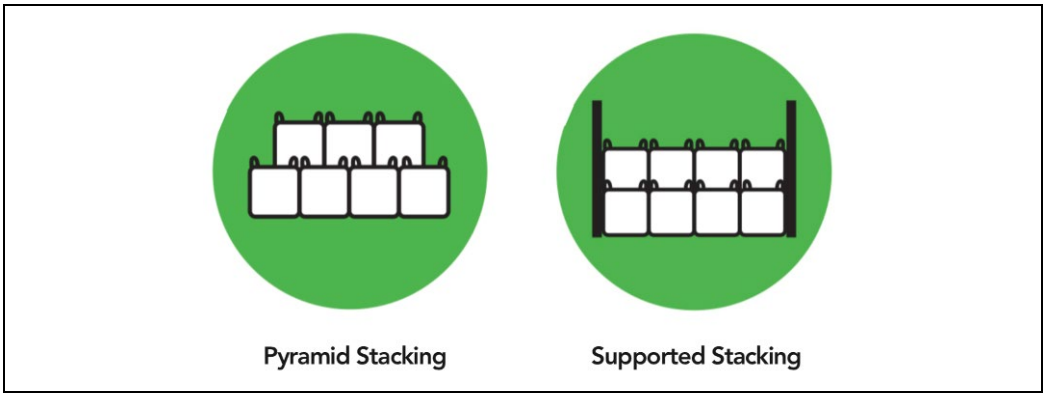
Road transport, and more specifically on board of a suitable fully covered truck, is the means most used to cover transport to point of further processing or export by sea. These routes must be specified and approved by the relevant authorities (PLANMalaysia, JKR and local authorities).

11.3.3 Safety and security in REC handling

REC product from a mine is normally in the form of cake, compressed by filter press as the final process, with a certain percentage of moisture. It may be considered as low volume, high value product and thus, relatively easy to store and transport. Hence, there is minimal safety issues with respect to the product handling during transportation, such as spillage on public roads. Other such examples such as leaks is equally extremely remote.

Source: FIBCA (2018)

Figure 11-1: Typical jumbo bag stacking arrangement during storage



Source: FIBCA (2018)

Figure 11-2: Typical jumbo bag stacking during storage and transportation

As for security, there is no major issue in view that REC, though it being of high value, such carbonates could not be directly used or realised easily as further processing is needed, that is currently not available locally. Furthermore, an AP is required to export the REC where stringent procedures are emplaced. Nevertheless, it is an obligation on the mine operator or other stakeholders to assure due consideration to the security aspect of the REC handlings.

11.4 PROCEDURE FOR THE EXPORT OF REC

JMG and KeTSA have established a system in handling application of export permit for minerals. The application of AP for REC would follow the same procedure.

11.4.1 Application for Surat Penilaian Teknikal (SPT)

Application of AP according to the relevant coding of KeTSA for the export of REC commences with the online application through eBMGPermit followed by SPT application to JMG. The process involved in the application is as shown in **Table 11-2**.

Table 11-2: Application process of AP for REC export

No.	Process	Notes
1.	A complete application shall be forwarded to KeTSA via AP online application system known as eBMGPermit.	
2.	The application shall be referred to the State JMG, the origin of the REC.	
3.	The State JMG shall give their view on the application through SPT for KeTSA consideration.	
4.	The process flow for the issuance of SPT is as shown in **Table 11-3** with the flowchart depicted in **Figure 11-3**.	

Table 11-3: The process for the application and Issuance of SPT

No.	Subject	Action	Remark
1.	Received application via eBMGpermit system	Pembantu Geosains/ Penolong Pegawai Geosains	
2.	Open file/SPT application registration for export	Pembantu Geosains/ Penolong Pegawai Geosains	✧ One file per company. ✧ Open sub-file for company having more than one (1) mine
3.	Check the application for completeness	Pembantu Geosains/ Penolong Pegawai Geosains	
4.	Proposed rejection of the application for incompleteness. Inform applicant to submit a new application.	Pembantu Geosains/ Ketua Lombong dan Kuari	

Table 11-3: The process for the application and issuance of SPT (Continued)

No.	Subject	Action	Remark
5.	If the application is complete, verify the information	Pembantu Geosains/ Penolong Pegawai Geosains	✧ Refer to the current enforced export ban/ policy ✧ To determine and confirm the information – quantity applied for export, stock ✧ Availability, monthly production, full payment of royalty
6.	Site inspection for a new application. Spot check for repeat application	Pembantu Geosains/ Penolong Pegawai Geosains	✧ Sampling if necessary ✧ Stock verification ✧ Photographs
7.	Recommendation – Approve/reject	Pembantu Geosains/ Ketua Lombong dan Kuari	✧ Check by the approving officer ✧ Application consideration for export ✧ Propose recommendations with conditions
8.	Preparation of SPT – Signature	Pegawai Geosains/Ketua Lombong dan Kuari	
9.	Send to BMG, KeTSA	Pembantu Geosains/ Penolong Pegawai Geosains	✧ Copy to HQ through system upload, post, fax, email

11.4.2 Application for AP

Before application of AP can proceed, the approval for export from PTG has to be obtained. Copy of the approval has to be submitted into the eBMGPermit system.

AP application for the export of REC commences with the application of SPT as explained earlier. Upon approval of the SPT, application for AP shall be made to KeTSA where due observation pertaining to the qualification of the applicant shall be examined. Under normal circumstances, ML/PML holder and mine operator or appointed contractor by the ML or PML holder with the Mineral Licence are eligible to submit for an application. Only applicants with valid documentations may be allowed to export the REC.

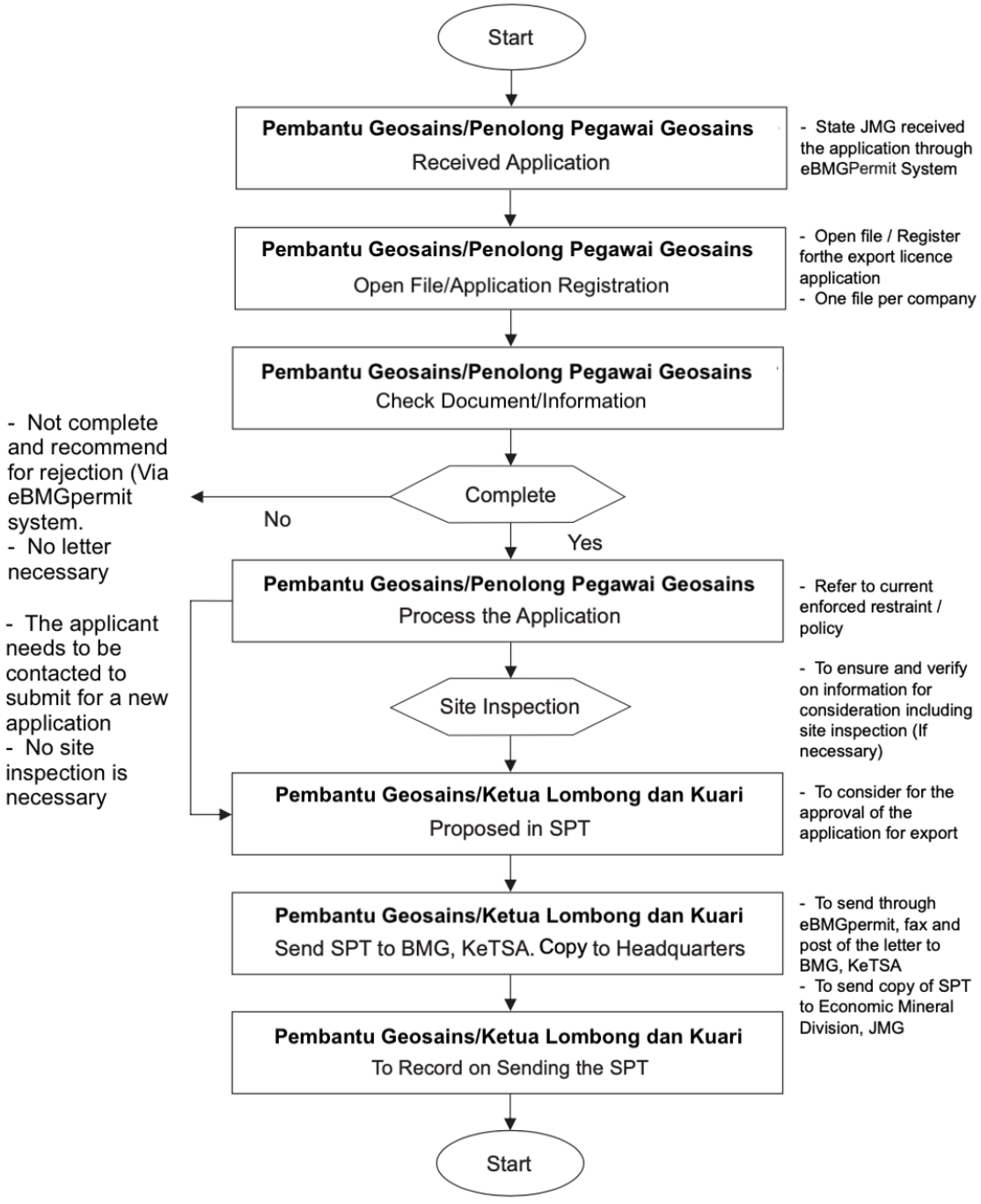


Figure 11-3: The process flow for the issuance of SPT

Issuance of AP shall only be made after the royalty has been fully paid. Royalty must be paid in accordance to the provision as stipulated in Mineral (Perak) Enactment 2003. The exporter shall pay the full amount of royalty to the State Authority within thirty (30) days of the AP approval. The procedure for the application of AP is as shown in **Table 11-4** with the process flow depicted in **Figure 11-4.**

Table 11-4: The process for the application and issuance of AP

No.	Subject	Action	Remarks
1	To apply for approval to export NR-REE from EXCO through PTG	Applicant	✧ Applicant to pay in full the amount of royalty due upon getting the approval.
2	Submission of AP with the approved relevant HS coding through eBMGPermit	Applicant	✧ Applicant to upload ML/PML, OMS and appointment documents as operator/contractor by the ML/PML holder.
3	To check and verify the application	BMG	✧ BMG shall check and verify each application based on the checklist for AP application. ✧ The applicant has to upload: K2 which has been appropriately filled, proforma invoice, the relevant licence/permit ✧ Mineral analyses including MSDS ✧ Sale contract.
4	Forward application to the State JMG for SPT proposal	BMG	
5	Checks by JMG and proposed SPT	JMG	✧ JMG shall investigate on the REC to be exported
6	JMG shall issue and upload the SPT in the eBMGPermit system	JMG	✧ SPT shall be issued with recommendation and forwarded to BMG
7	BMG to check on the application	BMG	✧ Checking on application ‘action by JMG completed’
8	Change in the quantity of REC based on JMG as in SPT.	BMG	✧ If no change on the REC quantity, propose for certification. ✧ If there is change in the REC, the applicant has to submit new Form K2 as proposed in the SPT and update the quantity of the REC in the system.
9	New application need to be done for any amendments/changes/ changes of information in		Changes on the following information: ✧ Consignor ✧ Consignee ✧ Port/export location ✧ Mode of transport

Table 11-4: The process for the application and issuance of AP (Continued)

No.	Subject	Action	Remarks
	The application form for the AP		✧ Former state ✧ Final destination state ✧ No. and type of parcel ✧ Goods description ✧ HS Code No. ✧ Unit ✧ Quantity according to custom tariff ✧ Actual unit freight value on board ✧ Total value

11.5 MINERAL ROYALTY

There are wide varieties of approaches across the globe in royalty payment in different countries with no clear trend for global convergence. However, the royalty tax system, at a global level, can be classified as one of the following types:

- ✧ Unit-Based
- ✧ *Ad Valorem* (Value Based)
- ✧ Profit Based

Due to the high value of REC, the *ad valorem* system is more appropriate. The *ad valorem* base system needs knowledge of mineral value. The simple type of *ad valorem* calculations used a measure of “realized value” based on customer invoices while the more complex methods may involve imputing a mineral value applied in a reported international reference price to some measure of mineral content. This route may require the assessment of an independent appraiser, in case of some minerals, using the imputed value deducting defined costs such as transportation, insurance and freight, etc.

11.5.1 Statutory requirements on royalty

As prescribed in Section 95(1) and subjected to sub-sections (5) and (8), the holder of an ML/PML shall pay to the State Authority royalty on any mineral won and sold or intended for sale; or won and utilised, or to be utilised, for any commercial or industrial purpose. Section 95(4) stipulates that the rate of royalty applicable to ML/PML holders shall be fixed for the first 10 years of the ML/PML, at the level prescribed as of the date the ML/PML was registered. Any changes in the prescribed rate of royalty, made after the date on which the ML/PML was registered shall not apply to ML/PML holder, during the said 10-year period.

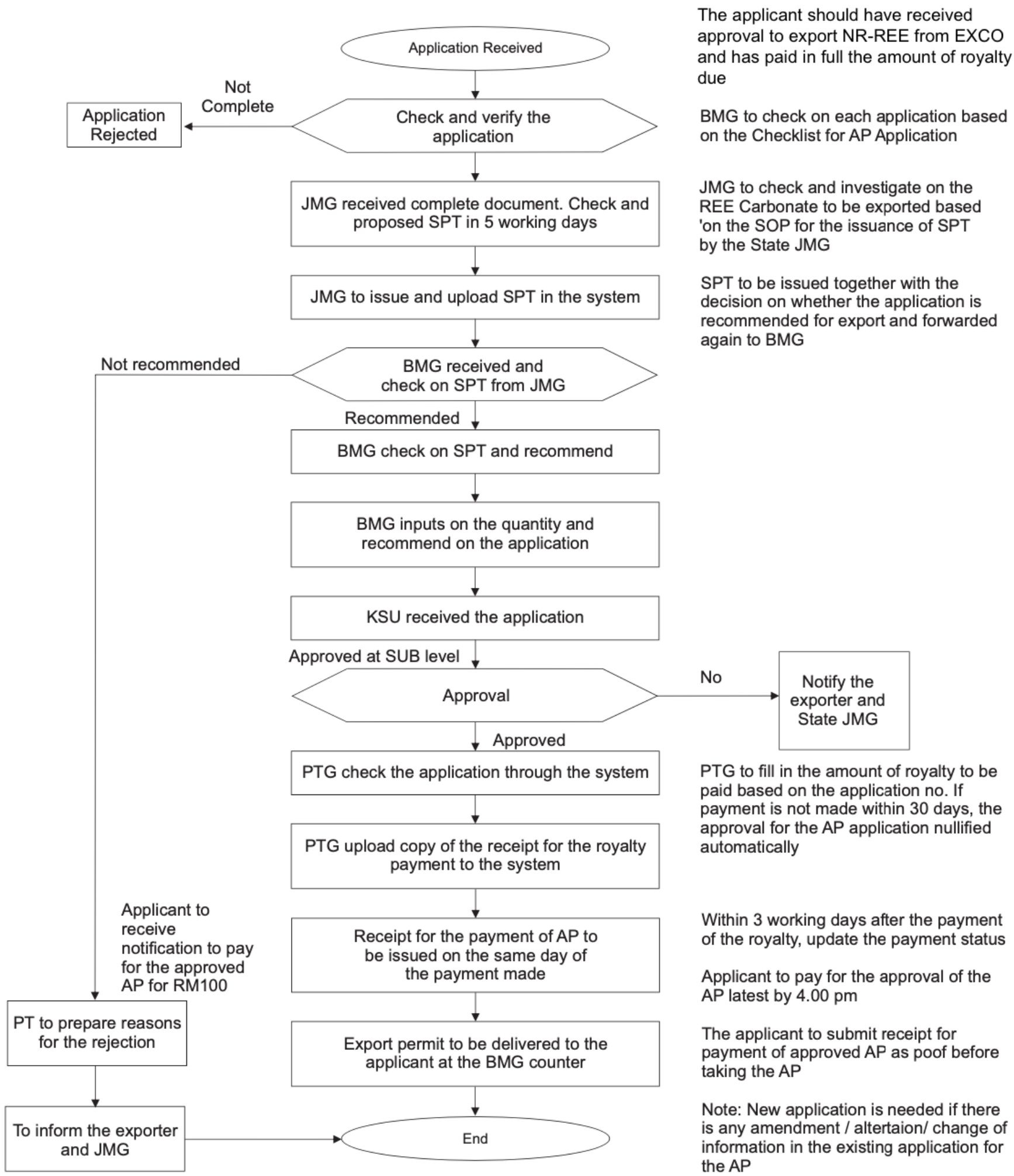


Figure 11-4: Flowchart of the issuance of Export Permit (AP) for REC under eBMGPermit system

Section 95(6) authorises the State Authority or any officer authorised in writing, to inspect and examine any books, records and accounts and obtain any information necessary, to ascertain the quantity or value of minerals won in respect of a mineral tenement, and any information necessary to verify the amount of any royalty payable.

11.5.2 Rate of royalty

Under Section 95(2), Mineral (Perak) Enactment 2003 and subjected to Clause(3B) of Article 110 of the Federal Constitution and sub-sections (3) and (4), the State Authority may prescribe the rate of royalty to be paid on any mineral. The amount of royalty for any mineral may be prescribed as follows:

- ✧ A percentage of the market value of the mineral won; or
- ✧ An amount payable on the basis of any specified volume or weight of the mineral won.

11.5.3 Market value

Section 96, Mineral (Perak) Enactment 2003 stipulates that for the purpose of paragraph 95(3)(a), the market value of any mineral shall be determined by such method and in such manner as may be prescribed.

In pursuance of Section 61(1) of Mineral (Perak) Regulations 2008, the method of determining the market value of the REC shall be based on the followings:

- ✧ The sales revenue realise by the holder of the mineral tenement.
- ✧ Reference to a monthly price for the mineral determined by the Director-General of Mines.
- ✧ Reference to a published price series for the mineral widely recognized and used by the international mining community as a reference price.

The State Authority shall determine the method of determining the market value of a mineral.

STAKEHOLDERS ENGAGEMENT

12.0

12.1 INTRODUCTION

NR-REE mining development and operation shall involve consultation with the relevant stakeholders, both the government authorities and the local community in the vicinity of the project site. In the mining industry, the term 'community' generally refers to the inhabitants of immediate and surrounding areas who are affected in some way by a company's activities; these effects may be economic, social or environmental, or any combinations thereof. Engagement with government agencies is done to make sure that the proposed project has taken into consideration various policies and procedures of relevance while engagement with the community is to obtain community acceptance, thus reducing public criticism, reputational risk and social conflicts. The community acceptance of the project, provides government and regulatory authorities with increased confidence in the industry and facilitates effective long term management of the resources.

12.2 COMMUNITY ENGAGEMENT

Community engagement is a series of stakeholder-community engagements that is able to comply with the social responsibility of an organisation for the impacts of its decisions and activities on society and the environment, through transparent and ethical behaviour. It creates opportunities for dialogue between an organisation, its stakeholders and the community.

12.2.1 Goals of community engagement

The aim of community engagement is to provide an informed basis for the organisation's decisions involving the following activities and expected to achieve goals as shown in **Table 12-1**.

Table 12-1: Expected goals of community engagement

No.	Goals	Notes
1.	Contribute to sustainable development, including health and the welfare of the society.	
2.	Take into account the expectations of stakeholders and the community.	
3.	Be in compliance with applicable laws and consistent with accepted norms of behaviour.	
4.	Be integrated throughout the organisation and practised in its relationships.	

- ✧ A series of activities is undertaken between the organisation, its stakeholders and the community to create opportunities for dialogue between the parties.
- ✧ Activities can be grouped under the categories of negotiation, consultation and exchange of information.
- ✧ These same activities must be able to comply with the social responsibility of the organisation for the impacts of its decisions and activities on society and the environment.

12.2.2 Community engagement plan

A community engagement plan documents the commitments that an ML/PML holder makes to their community. A community engagement plan shall be created after a deliberate and planned process. Steps to assist in the development of a community engagement plan is presented in **Table 12-2**.

Table 12-2 Recommended steps to assist in development of a community engagement plan

No.	Development steps	Notes
Key steps		
1.	Identify any individual or community impacted or affected by the project. ✧ Community of place – Communities surrounding a geographic location, such as neighbouring properties. ✧ Community of impact – Communities that may be impacted by the said project. ✧ Community of interest – Communities of similar practice, such as local community groups, residents' associations, farmers' groups, local businesses, local schools, tourist or seasonal groups and other NGOs. ✧ Community of standing – communities that have a special or legal interest in the land, such as Indigenous communities or some environmental groups.	

Table 12-2 Recommended steps to assist in development of a community engagement plan (Continued)

No.	Development steps	Notes
2.	Identify and manage community attitudes and expectations. ✧ Effective community engagement raises awareness of broad perspective in relation to social and cultural impacts, environmental effects and economic consequences of any decisions or proposed change.	
	✧ Engaging a cross-section of the community provides the best opportunity to build a shared understanding of these factors. ✧ Community attitudes and expectations can be identified through a range of techniques. ✧ Ideally, this activity should be undertaken during the planning stage of a project, prior to the development of the work plan. ✧ Cross-cultural awareness, the rights, beliefs, values and interests of all sections of the community should be a key consideration.	
3.	Assess the level of actual or perceived impact for the identified community. ✧ Values are the personal standards that direct the opinions we hold and the actions we take. They are the core of what it means to be human and for communities they give a sense of identity and connection. ✧ Our values shape our beliefs, our beliefs shape our opinions and our opinions drive our actions.	
4.	Decide on what decisions the community can be engaged in. ✧ To reduce the risk of differences in expectations, ML/PML holders must be clear about why they engage with the community and what they hope to achieve. ✧ To develop a statement about a decision to be made – Carefully and clearly summarise the intent and issues to be dealt with, and to provide details of what the community is being asked to participate in and why.	
5.	Choose the most appropriate level to engage the community. ✧ What are the community's values, concerns, attitudes and aspirations? ✧ What are the community's expectations in regard to balanced and objective information? ✧ What is the best way to communicate with the community? ✧ What might the community need in order to have confidence in the information we are providing? ✧ What are the main messages going to be?	
6.	Select the community engagement techniques to be used. ✧ There are a vast number of ways or techniques available for engaging with the community –Written material, information	

Table 12-2 Recommended steps to assist in development of a community engagement plan (Continued)

No.	Development steps	Notes
	✧ sheets and newsletters, or undertaking face-to-face interactions, such as meetings, workshops, events and committees. ✧ Rather than taking a rigid approach when choosing engagement techniques, ML/PML holder should consider using a combination of techniques with formal and informal	
	engagement to increase the likelihood of different members of a community being able to participate in a way that suits them. ✧ Informal engagement techniques can include one-on-one discussions and informal conversations. These are important in forming and maintaining relationships and understanding personal perspectives.	
Community engagement plan		
1.	A description of any engagement activities undertaken to date	
2.	Who has business responsibility for the activity, when it will occur and where	
3.	Processes to ensure the licensee has systems and procedures in place to understand and respond to community issues on an ongoing basis	
4.	A complaints and issues resolution process	
5.	Processes that provide the opportunity for relationships to be built proactively, not just when issues occur	

12.2.3 Corporate Social Responsibility (CSR)

Corporate social responsibility (CSR) is an important aspect especially in mining. It is a critical tool to win trust, especially for large corporations to build a strong and fruitful relationship with the community. CSR is an important step forward in carrying out educational and awareness efforts, towards operational activities that are perceived to have a negative impact on the environment and society. Extraction of NR-REE using the proposed ISL mining method is indeed an activity of such tendency. Thus, CSR constitutes an important aspect of compensating community and their natural environment for the inconveniences stemming from the proposed operation. In return, the society would have a more positive perception towards the project and would bring such an activity closer to people. This allows them to become an important, integral part of such a venture, which ultimately brings positive return in morale and investment. It causes a simultaneous increase of social trust and an improvement of the industry image in the context of social license to operate as a tool for CSR activities.

12.3 ENGAGEMENT WITH RELEVANT AGENCIES

Government policies, legislations and regulations relevant to the proposed NR-REE project shall be identified. Local plans and policies will also be evaluated. Project characteristics will be analyse to ensure compliance with these policies, legislation and regulations. Appropriate recommendations will be provided to ensure regulatory compliance. Discussions and meetings may be carried out with various Government Agencies; with JMG being the key agency and other agencies as listed in **Table 12-3.**

Table 12-3: Stakeholders consultation from the government agency, local community, NGOs and others

Study, Report, Application	Government Agency/Community/NGOs/Others																
	JMG	KeTSA	PTG	Pejabat Tanah Daerah	JAS	JKKP	PLANMalaysia	PBT	JPS	Jabatan Kemajuan Orang alaAsli	JPSM	Jabatan Perhilitan	Jabatan Pertanian	AELB	Local Community	NGOs	Others
PRE-MINING OPERATION																	
PL/EL Application	x		x	x													
✧ NR-REE Potential Report (Application Area)																	
✧ Form 5A/Form 6A																	
PL/EL Holder (Approval Compliances)	x		x	x													
✧ Exploration (Field)																	
✧ Exploration (Laboratory)																	
✧ Reserve Evaluation																	
✧ Reporting																	
ML/PML Application	x		x	x	x												
✧ Form 8A / Form 9A																	
✧ OMS Report (Conceptual)																	
✧ Rehabilitation Plan																	
✧ Pre-Feasibility Report																	
EIA	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	
✧ Term of Reference (TOR)																	
✧ EIA Preparation and Submission																	

Table 12-3: Stakeholders consultation from the government agency, local community, NGOs and others (Continued)

Study, Report, Application	Government Agency/Community/NGOs/Others																
	JMG	KeTSA	PTG	Pejabat Tanah Daerah	JAS	JKKP	PLANMalaysia	PBT	JPS	Jabatan Kemajuan Orang alaAsli	JPSM	Jabatan Perhilitan	Jabatan Pertanian	AELB	Local Community	NGOs	Others
✧ Approval Process																	
PLANNING PERMISSION (KM)	x		x	x	x		x	x	x	x	x	x	x	x	x	x	
SOCIAL IMPACT ASSESSMENT (SIA)	x		x	x	x		x	x	x	x	x	x	x	x	x	x	
OMS	x				x												
✧ Reserve Evaluation																	
✧ Geological Study																	
• Hydrogeology																	
• Structural																	
• Geotechnical																	
• Geomorphology																	
✧ Mine Design and Planning																	
✧ Mining Scheme																	
✧ Mineral Processing / Beneficiation																	
✧ Mine Safety Management																	
✧ Mine Rehabilitation Plan																	
PRE-FEASIBILITY / FEASIBILITY STUDY	x		x														
✧ OMS																	

Table 12-3: Stakeholders consultation from the government agency, local community, NGOs and others (Continued)

Study, Report, Application	Government Agency/Community/NGOs /Others																
	JMG	KeTSA	PTG	Pejabat Tanah Daerah	JAS	JKKP	PLANMalaysia	PBT	JPS	Jabatan Kemajuan Orang alaAsli	JPSM	Jabatan Perhilitan	Jabatan Pertanian	AELB	Local Community	NGOs	Others
✧ Capital Cost																	
✧ Operating Cost																	
✧ Cashflow																	
✧ IRR / ROR																	
EMP					x												
✧ Conditions of Approval (COA)																	
✧ OMS																	
✧ ESCP / LDP2M2																	
✧ Environmental Competency																	
ESCP / LDP2M2					x												
✧ OMS																	
✧ ESC																	
✧ BMPs																	
REHABILITATION PLAN	x																
✧ OMS																	
✧ ESCP /LDP2M2																	
✧ Implementation Plan and Schedule																	

Table 12-3: Stakeholders consultation from the government agency, local community, NGOs and others (Continued)

Study, Report, Application	Government Agency/Community/NGOs/Others																
	JMG	KeTSA	PTG	Pejabat Tanah Daerah	JAS	JKKP	PLANMalaysia	PBT	JPS	Jabatan Kemajuan Orang alaAsli	JPSM	Jabatan Perhilitan	Jabatan Pertanian	AELB	Local Community	NGOs	Others
MINING OPERATION																	
OMS (Implementation)	x																
✧ ISL IAC Deposits																	
✧ REC Beneficiation																	
✧ OMS Mine Safety Management																	
✧ Geotechnical/Slope Stability																	
EMP (Implementation)					x												
✧ Environmental Mainstreaming																	
✧ Environmental Monitoring and Auditing																	
✧ Environmental Competency																	
✧ Compliance Reporting																	
ESCP/LDP2M2 (Implementation)					x												
✧ BMPs Maintenances																	
✧ Compliances																	
REC STORAGE, TRANSORT AND EXPORT	x	x	x														
✧ REC Export Permit Application																	
✧ REC Transportation Procedure																	

Table 12-3: Stakeholders consultation from the government agency, local community, NGOs and others (Continued)

Study, Report, Application	Government Agency / Community / NGOs/Others																
	JMG	KeTSA	PTG	Pejabat Tanah Daerah	JAS	JKKP	PLANMalaysia	PBT	JPS	Jabatan Kemajuan Orang alaAsli	JPSM	Jabatan Perhilitan	Jabatan Pertanian	AELB	Local Community	NGOs	Others
✧ RE Transport Permit Application																	
✧ RE Port Storage Procedure																	
✧ RE Royalty Payment Procedure																	
STAKEHOLDERS ENGAGEMENT																	
✧ Engagement with relevant agencies	x		x	x	x	x	x	x	x	x	x	x	x	x			
✧ Engagement with local community															x	x	
✧ Corporate Social Responsibility			x												x	x	
✧ Social Licence to Operate															x	x	
PROFESSIONALS AND SKILLED HUMAN CAPITAL	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	
POST MINING OPERATION																	
MINE CLOSURE PLAN	x		x	x	x	x											
✧ PostMining Rehabilitation																	
✧ Post Mining Monitoring																	
✧ Post Mining Auditing																	

MINE PROFESSIONALS, SKILLED WORKERS AND TRAINING REQUIREMENTS

13.0

13.1 INTRODUCTION

In order to maintain high technical competencies in the mining and processing of NR-REE, it is important for the industry to have and foster core competencies for technical professionals in various positions, with regards to their activities at various stages of development and operation. Competent professionals coupled with skilled workforce propagate national excellence in the industry. However, one of the most challenging areas for the mining industry has always been managing and maintaining a skilled workforce. The stakeholders are certainly aware of the importance of its human capital and its direct impact on the sustainability of the country's mineral industry.

13.2 ROLES OF PROFESSIONALS

Mineral exploration is the initial step in most of mining ventures. It covers a wide range of earth science disciplines including geology, geochemistry, geophysics, and remote sensing (which incorporates satellite imagery and multispectral data interpretation). Once a mineral discovery has been made, and determined to be of sufficient economic quality to mine, mining engineers will then work on developing a plan to mine this effectively and efficiently.

At the same time, all the other elements of the project must be considered and studied with ample detail to discover any fatal flaws or problems that may require engineering mitigation. Certainly, environmental and socio-economic issues need to be considered, scrutinised and scoped to the extent that any existing or expected problems will be detected. Then, all of these items can be examined for future cost and work plans, where relevant professionals shall contribute effective roles in ensuring all planning and operation goes well.

A list of technical studies, assessments, monitoring and the reporting (that needs to be made) to various authorities, and its specific disciplines are shown in **Table 13-1**.

Table 13-1: Professional inputs on technical studies, assessments, monitoring and reporting of NR-REE mine development and operation

Study, Report, Application	Professional/Specialist inputs						
	Engineering	Geology	Environment	Ecology	Socio-economy	Public Health Specialist	Others
PRE-MINING OPERATION							
PL/EL application							
✧ NR-REE Potential Report (application area)	x	x					
✧ Form 5A/Form 6A	x						
PL/EL holder (Approval compliances)							
✧ Exploration (Field)	x	x					
✧ Exploration (Laboratory)		x					
✧ Reserve Evaluation	x	x					
✧ Reporting	x						
ML/PML application							
✧ Form 8A/Form 9A	x						
✧ OMS Report (Conceptual)	x						
✧ Rehabilitation Plan	x						
✧ Pre-Feasibility Report	x						
EIA							
✧ Term of Reference (TOR)	x	x	x	x	x	x	
✧ EIA Preparation and Submission	x	x	x	x	x	x	
✧ Approval Process	x	x	x	x	x	x	
OMS							
✧ Reserve Evaluation	x	x					
✧ Geological Study		x					
• Hydrology and Hydrogeology	x	x					
• Geology and Geotechnical		x					
• Geomorphology		x					
✧ Mine Design and Planning	x		x				
✧ Mining Scheme	x		x				
✧ Mineral Processing	x						
✧ Mine Safety Management	x						
✧ Mine Rehabilitation Plan	x		x	x			
PRE-FEASIBILITY/FEASIBILITY STUDY							
✧ OMS	x		x				
✧ Reserve Evaluation	x	x					
✧ Capital Cost	x						
✧ Operating Cost	x						
✧ Cashflow	x						

Table 13-1: Professional inputs on technical studies, assessments, monitoring and reporting of NR-REE mine development and operation (Continued)

Study, Report, Application	Professional/Specialist inputs						
	Engineering	Geology	Environment	Ecology	Socio-economy	Public Health Specialist	Others
✧ IRR/ROR	x						
EMP							
✧ Conditions of Approval (COA)	x		x				
✧ OMS	x		x				
✧ ESCP/LD-P2M2	x		x				
✧ Environmental Competency	x		x				
ESCP/LD-P2M2							
✧ OMS	x		x				
✧ ESC	x		x				
✧ BMPs	x		x				
REHABILITATION PLAN							
✧ OMS	x						
✧ ESCP/LD-P2M2	x		x				
✧ Implementation Plan and Schedule	x	x	x	x			
MINING OPERATION							
OMS (Implementation)							
✧ ISL Ion-adsorption Clay Deposit	x	x					
✧ REC Processing	x						
✧ OMS Mine Safety Management	x	x					
✧ Geotechnical/Slope Stability	x	x	x				
EMP (Implementation)							
✧ Environmental Mainstreaming	x		x				
✧ Environmental Monitoring and Auditing	x		x				
✧ Environmental Competency	x		x				
✧ Compliance Reporting	x		x				
ESCP/LD-P2M2 (Implementation)							
✧ BMPs Maintenances	x		x				
✧ Compliances	x		x				
RE STORAGE, TRANSORT AND EXPORT							
✧ RE Export Permit Application	x	x					
✧ RE Transportation Procedure	x						
✧ RE Royalty Payment Procedure	x	x					
STAKEHOLDERS ENGAGEMENT							
✧ Engagement with Relevant Agencies	x	x	x	x	x		
✧ Engagement with Local Community				x	x		
✧ Corporate Social Responsibility			x	x	x		

Table 13-1: Professional inputs on technical studies, assessments, monitoring and reporting of NR-REE mine development and operation (Continued)

Study, Report, Application	Professional/Specialist inputs						
	Engineering	Geology	Environment	Ecology	Socio-economy	Public Health Specialist	Others
✧ Social Licence to Operate				x	x		
POST-MINING OPERATION							
MINE CLOSURE PLAN							
✧ Post-mining Rehabilitation	x	x	x	x	x		
✧ Post-mining Monitoring	x	x	x	x	x		
✧ Post-mining Auditing	x	x	x	x	x		

13.2.1 Professional Mining Engineers

Professional Mining Engineer or Mineral Resource Engineer with Practicing Certificate pursuant to Section 10D of the Registration of Engineers Act (Revised 2015) may carry on business or take up employment which requires him to carry out or perform professional engineering services for designated engineering works subject to section 8 of the Act. In this respect, there are many provisions in the Mineral Development Act 1994 and the Mineral (Perak) Enactment 2003 that specifies the roles of a Professional Mining Engineer or a Mineral Resource Engineer pertaining to specific tasks, such as in the preparation and submission of OMS, mine rehabilitation plan, and mine feasibility study for a proposed mining operation.

13.2.2 Professional Geologists

Professional Geologist registered under Section 20(3), Geologist Act 2008, is a competent person to practice geology/geoscience in Malaysia. The practise of professional geology (geoscience) is essentially carrying out of any activity that requires application from the principles of geological sciences, and that concerns the safeguarding of public welfare, life, health, property, or economic interests, including, but not limited to: (1) Investigations, interpretations, evaluations, consultations or management aimed at discovery or development of metallic or non-metallic minerals, rocks, nuclear, fossil fuels, precious stones and water resources, (2) investigations, interpretations, evaluations, consultations, or management relating to geoscientific properties, conditions or processes that may affect the well-being of the general public, including those pertaining to the preservation of the natural environment.

13.3 TRAINED AND COMPETENT PERSONS

A trained and competent person in a mine is important for the smooth implementation and operation of the project. Some of the important trained and competent persons required at the mine in ensuring the smooth running of the operations, are as follows (inexhaustive):

- ✧ Mine Manager
- ✧ Mining Engineer
- ✧ Mining Geologist
- ✧ Mineral Processing Engineer
- ✧ Environmental Officer (EO)
- ✧ Safety, Health and Environment (SHE) Officer
- ✧ Field Supervisors
- ✧ Environmental Auditor

Some of those with specific statutory roles are described below.

13.3.1 Mine Manager

Notwithstanding of the above list of competent persons, the position of a Mine Manager shall be carrying statutory responsibilities under the Mineral Development Act 1994. Mine Manager is a person appointed under Section 14(1), Mineral Development Act 1994 and as stipulated under Section 14(7), shall be responsible for the following roles:

- ✧ Shall be responsible for the control and daily supervision of the mine of which he has been appointed manager; and
- ✧ Reside in close proximity to such mine unless exempted in writing by the Assistant Director.
- ✧ Supervising the working of the mine.

The Mine Manager will also generally be responsible for the following environmental management aspects:

- ✧ Implementing and enforcing appropriate environmental, safety and health practices at the project work area.
- ✧ Ensuring that all on-site planning considers the safety of personnel and the protection of the environment.
- ✧ To ensure compliance with applicable regulations, as outlined in the final approved EMP.

- ✧ Coordinating and implementing the environmental control measures as detailed in the final approved EMP.
- ✧ Assigning on-site environmental personnel to oversee implementation of the mitigation measures, and ensure compliance with environmental requirements;
- ✧ Overseeing the Environmental Monitoring Program (EMP).
- ✧ Liaising with the relevant government departments as required; and
- ✧ Seeking the advice of the EMP Consultant regarding any environmental issues of concern.

13.3.2 Environmental Officer (EO)

EO works closely with the appointed contractors (and the EMP Consultant) to formulate the Final EMP prior to start of the mine. This is continued during the construction and operation phases, to allow continuous refining of work methods and procedures to ensure environmental quality objectives are met, and work schedules and production is optimised. JAS requires the EO to be on-site full time. The expected responsibilities of the EO include the following:

- ✧ Coordinate implementation of the environmental management program.
- ✧ Direct environmental awareness inductions and relevant material distribution arrangements.
- ✧ Perform regular internal audits of sub-Contractor's implementation, with regards to the environmental protection activities including waste management, housekeeping and erosion and sediment control measures.
- ✧ Maintain an independent Environmental Management File and associated database for all activities pertaining to environmental management of the works, and in particular, audit schedules and outcomes.
- ✧ Coordinate environmental incident investigations and report findings to the Mine Manager.

13.3.3 Health and Safety Officer

The duties of the Health and Safety Officer are as follows:

- ✧ To advise and coordinate all matters pertaining to health and management associated with the mining activity on-site.
- ✧ To ensure compliance with applicable legislation and guidelines.
- ✧ To ensure all emergency control equipment, safety equipment and environmental protection measures on-site are properly implemented.
- ✧ To investigate and report health and safety incidents and non-conformances to the Mine Manager.

- ✧ To ensure good communication between the project team and government agencies with respect to the environment matters.
- ✧ To collect, update and maintain proper records on safety and health incidences.

13.4 SKILLED AND GENERAL MINEWORKERS

Mining jobs for skilled workers will most likely be available because of the nature of the work, and the opportunity for skilled workers to move from one mine site to another. Skilled mine workers are most likely to be trade-qualified and may come from a mining or quarrying background. There is a long list of mining jobs for skilled and unskilled workers as shown in **Table 13-2** which should be filled **by locals as the first preference**.

Table 13-2: List of skilled and general mine workers can be filled by locals

Jobs designations	Job descriptions (Typical)
Carpenter	Makes, assembles, alters and repairs wooden structures and articles using hand or power tools or both.
Chargehand	Instructs and directs operators in assembling and erecting different kinds of selector, racks, relay set sacks, etc.
Chargeman	Operates motor generator and other electrical equipment.
Checker	Verifies quantity, quality, condition, value and types of goods produced or material purchased and sold with reference to records and reports of specifications. Checks proper markings and labels according to instructions.
Compressor Operator	Operates and services power driven air compressor which generates and supplies compressed air to drive pneumatic tools, hoists and other mechanical equipment.
Chemical Doser/Operator (Chemical Injection)	Starts and switches off chemical pumps, operates valves to adjust injection, rates and pressures. Places and removes charts from meter and records. Makes minor adjustment to meters. Prepares chemical.
Crane Operator	Operates stationary or mobile overhead crane to transport material.
Driller	Drills holes on the ground for exploration according to specifications.
Driver	Drives trucks, lorry, car or tractor for transporting goods or men. Attends to minor repairs.
Electrician	Installs, maintains and repairs electrical machinery, equipment and fittings. Repairs or replaces defective wiring, burnt out fuses, defectives parts and keeps fittings in working orders.

Table 13-2: List of skilled and general mine workers can be filled by locals (Continued)

Jobs designations	Job descriptions (Typical)
Engine Room Attendant	Looks after engine room. Operates engine in the event of failure of electricity.
Fitter	Sizes metal parts accurately according to drawings by sawing, chipping, filling, scrapping, drilling etc. Fits and assembles them as required and does necessary repairs himself.
Foreman (Mechanical/ Electrical)	In-charge of group of workers in his department. Supervises & guides workers engaged in various processes and controls operations of respective departments.
Gas Cutter/Flame Cutter	Cuts metal to require shape and size by flame either manually or mechanically.
Generator Operator	Operates the generator / turbo generator used for producing electricity. May clean and oil machine.
Helper	Helps the skilled workers in their jobs. Performs various types of semi-skilled and unskilled jobs.
Instrument Mechanic	Tests, repairs and overhauls various instruments and their parts for efficient performance.
Lineman	Erects and maintains overhead electric power lines to supply electricity to the place of use.
Loader/Unloader	Loads / unloads heavy materials, etc. from wagons and trucks.
Machine Operator/ Machinist	Operates one or more types of machines such as grinding boring, milling, moulding, shaping, drilling, computer numerical control etc. used for various operations. May clean and oil machine.
Mechanic (General)	Attends to installation, repair, maintenance and examination of various types of machinery.
Motor Mechanic	Repairs, overhauls and services motor vehicles to keep them in good running order. Also carries out repairs of internal combustion engines.
Oilman/Greaser	Cleans and lubricates various types of engines or machinery. May make minor adjustments, tighten loose parts and assist machine operators or mechanics.
Plumber	Lays out, assembles, installs and maintains sanitary fittings and fixtures, sewage and drainage system, gas & water pipelines, etc.
Pump Attendant	Operates power driven pumps for pumping, storing and supplying liquids. May also repairs and clean, oil and grease the pump.
Rigger	Erects lifting and hauling pulleys, wire ropes, etc. to lift, move or lower heavy articles.

Table 13-2: List of skilled and general mine workers can be filled by locals (Continued)

Jobs designations	Job descriptions (Typical)
Storekeeper	Receives and issues various types of goods, tools, equipment and raw materials and maintains records of each such items. Ensures proper storage and preservations of these items in the storeroom.
Supervisor	In-charge of a group of workers in his unit. Guides and supervises the workers under his charge. Also handles intricate jobs himself.
Sweeper	Cleans and sweeps factory premises, toilets and removes garbage.
Switch Board Attendant	Operates and attends to switches and switch gears on switch board to regulate flow of electric current from power house or sub-station to different feeding units
Watchman	Guards buildings, premises, industrial plants, ware houses, etc. against fire, theft, illegal entry and other such contingencies.
Weigher	Weighs materials and products to determine whether they conform to specifications for use in production processes or for purposes of trade and commerce, using balance, platform or floor.
Welder	Welds, cuts or fuses metal parts with electric arc/gas flame by hand or machine. May strengthen the joints with molten metal.
Winch Driver	Operates power driven winch (winding engine) for hauling up and down men or materials.
Unskilled Worker	Performs various unskilled jobs such as lifting and carrying loads, cleaning and sweeping loom sheds, machine rooms, etc.

13.5 TRAINING REQUIREMENTS

Training of personnel in specialised areas shall be a mandatory requirement and shall need to be provided by the Project Proponent. The training will enable each employee to execute their duties diligently. In addition, the trained staff shall carry the responsibility and shall be able to recognise and report any environmental hazards at the workplace, plus, shall be able to mitigate such hazards. The Project Proponent shall assure that each employee has been trained, as necessary, by a competent person qualified in the relevant and related areas.

The objectives of training requirements for the workers and personnel of the project are as follows:

- ✧ To develop competency to discharge responsibilities on environmental requirements and compliance.

- ✧ Maintaining and enhancing their existing technical knowledge and professional skills;
- ✧ Learning new skills and deepen their understanding on specific areas.
- ✧ Keeping abreast with the latest issues and developments in the subject areas.
- ✧ Maintaining constant contact with operational aspects of the subject area for example, Industrial Effluent Treatment Systems (IETS) operation, or scheduled waste management, or air pollution systems, etc.
- ✧ Enhancing technical knowledge on the subject area for example, IETS, or scheduled waste management, pollution control systems or other areas of environmental management.

13.6 SCOPE OF TRAINING

Training requirements shall cover various categories; technical, management and competency relevant to the project operation. Certain specialised on-job training related to Ion-Adsorption ISL mining and processing should also be conducted.
An already been trained employee but still does not have the understanding and skill required, retraining for such employee is necessary. Circumstances where retraining is required include, but are not limited to, (1) Situations where changes in the workplace render previous training obsolete; (2) Changes in the working systems or equipment to be used where familiarization is necessary.

13.6.1 Training on LDP2M2 and other regulatory compliances

The training areas shall include maintenance and performance monitoring of all P2M2, relevant to the project, which shall include the followings:

- ✧ Land Disturbing, Pollution Prevention and Mitigation Measures (LDP2M2).
- ✧ Clean Air Regulation (CAR).
- ✧ Certified Environmental Professional in Scheduled Waste Management (CePSWaM).
- ✧ Industrial Effluent Treatment System (IETS).
- ✧ Industrial Effluent Regulation (IER).
- ✧ Scheduled Waste Regulation (SWR).
- ✧ Emergency Response Plan (ERP).

13.6.2 Training on safety, health and environment (SHE)

Safety and health training of personnel and workers shall be carried out based on their respective job requirement. The Project Proponent shall be committed to provide such training for the purpose of workers knowledge enhancement and also for implementing

on job environmental, safety and health practices. The frequency of the training is proposed based on the frequency deemed necessary.

The training for personnel on safety and emergency response measures shall strictly be pursued by the management. Updated training schemes will form the basis in guiding staff to act instinctively to abnormal situations and to report such incidents in the proper manner, so that mitigating, and control measures can be implemented speedily to avoid catastrophic incidents. Appropriate training courses will impart the necessary knowledge and essential practical experience (where necessary) to all staff, on how to, in the first place, avoid potential accidents. The basic training to be provided to new staff recruited includes:

- ✧ On-the-job training on the types of safety equipment to be used when carrying out specific job functions; as well as on the safety procedures and approaches to be adopted in executing various job functions.
- ✧ The essential safety topics which shall include spill and emission controls, various aspects of safety management, safe operation of equipment and stockpiling.
- ✧ Follow-up training shall be carried out by the supervisor so that staff are continuously reminded and updated on potential hazard situations, and on safety and environmental response procedures that need to be followed and applied as and when necessary.

As a general rule, any staff directly involved with the equipment handling will, on appointment, receive formal training on the particular tasks that they have to perform. This includes imparting knowledge and skill relevant to the operation. In addition to this specific training program, processing plant personnel of all categories will undergo a series of familiarization lectures aimed at imparting the following essential knowledge and information, viz:

- ✧ Company’s environmental policy.
- ✧ Synopsis of the basic overall process concept of the mining operation and the particular function each staff member plays in ensuring optimum operations. The review will include familiarisation of the mine layout arrangements, identification of restricted areas, knowledge of communication systems, and organisational responsibilities.
- ✧ Complete knowledge and understanding of mining operation and mine products.
- ✧ Established emergency alarms, and evacuation procedures (including reporting to specific emergency stations), and safety measures.
- ✧ Detention and reporting of abnormal situations having potential health and environmental repercussions. This would include complete familiarisation with spill protection and emission control and containment programs.

- ✧ Good housekeeping practices and desired behavioural attitudes of employed staff.

13.6.3 Specialised training on sustainable mining operation

Realignment of governance and practices towards mining sustainability at every NR-REE mining project cycle phase is necessary. Training and courses to achieve the following targeted outcome should also be considered by the Project Proponent:

- ✧ To design and operate NR-REE mine, in sustainable manner, solving the possible risks at source as to deal issues using traditional 'end of pipe' treatments is expensive, energy-intensive and unsustainable. Reducing possible impacts by BMPs, managed by professionals with integrity and complying with all the statutory requirements is a possible solution.
- ✧ The NR-REE mining operators and stakeholders need guidance in managing their operation. Provisions for Approved Code of Practices, Guidelines and Standard Operating Procedures on various salient activities need to be developed and implemented. With these documents in place, there will be no room for irresponsible operators in the industry.
- ✧ Education and awareness at all levels of stakeholders including mineral tenement holders, mine operators, government authorities and the community on NR-REE mining and processing. This includes capacity building among consultants and government officer.

13.7 TRAINING BUDGET PROVISIONS

Financial commitment shall be made by the Project Proponent in the form of budget allocations for the training requirement for the project manpower.

PART 4
POST-MINING OPERATION

MINE CLOSURE PLAN

14.0

14.1 INTRODUCTION

Mine closure encompasses the rehabilitation process as an ongoing program designed to restore physical, chemical and biological quality disturbed by the mining to a level acceptable to all concerned. It aims to leave the area in a condition that appears intact, so that rehabilitation does not become a burden to society after mining operation is over. It also aims to create as a self-sustained ecosystem with adequate check and balance.

Mine closure operation is a continuous series of activities starting from day one of the initiation of a mining project. Therefore, a progressive mine closure plan shall be an important item covered in the OMS of the mine, which need a review from time to time over the entire mine life. As progressive mine closure is a continuous series of activities, it is obvious that the mining scheme has included most of the activities in the progressive mine closure plan. Therefore, reference to relevant paragraphs and a gist of the same in the progressive mine closure plan will be sufficient.

14.2 STATUTORY REQUIREMENT

As shown in **Figure 1-2**, mine closure is the last phase in the mining cycle since mining is a temporary activity. Upon abandonment and closure of a mining operation, the ML/PML holder has the statutory duty provided under the Mineral Development Act 1994 to carry out rehabilitation works as presented in **Table 14-1**. Thus, the mine closure plan should be read together with the rehabilitation plan as presented in **Chapter 8** of this SOP. Rehabilitation is a vital component of a mine closure plan.

14.3 MINE CLOSURE PLAN

Final mine closure plan as per the statutory requirement (Mineral Development Act 1994), shall be considered to have its approval well in advance before the date of the proposed closure of mine. Therefore, all proposals for activities which have to be carried out after production of mineral from the mine or mining has ceased operation, shall be

included in the final mine closure plan. The final mine closure plan will thus be a separate document with detailed programs and activities to be implemented. **Table 14-2** presents information that needs to be included in mine closure plan for submission to the relevant authorities.

Table 14-1: Statutory requirements on mine closure and mine rehabilitation as prescribed

No.	Provisions	Notes
Mineral Development Act 1994		
Mine closure		
1.	Section 20(1) – To give three (3) months written notice to JMG before any mining operations is abandoned or discontinued.	
2.	Section 20(2) – To provide to JMG an accurate plan showing the workings of such mine up to the time of abandonment.	
3.	Section 20(3) – To securely fence or cover every mine shaft or adit of abandoned mines to the satisfaction of JMG.	
4.	Section 20(4) – To make safe the abandoned mines and waste in such manner as may be prescribed.	
Mineral (Perak) Enactment 2003 (Derived)		
Mine rehabilitation		
1.	Section 126 – The right to mine of the holder of ML/PML is contingent on obtaining approval of mine rehabilitation plan as prescribed in Section 64(1)(b).	
2.	Section 126 – The mine rehabilitation plan, shall provide the following: ✧ Specific rehabilitation actions. ✧ Inspections. ✧ Annual reports. ✧ Estimated total cost for rehabilitation. ✧ Cost estimates for each specific rehabilitation action. ✧ A detailed timetable for the orderly and efficient rehabilitation of the mining land.	
3.	Regulation 3(1)(s) of the Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007 – The submission of OMS under Section 10(1) Mineral Development Act 1994 to include information on the proposed progressive rehabilitation and post mine closure plans.	
Environmental Quality Act 1974 (Derived)		
1.	Section 34A(3) – To comply with Conditions of Approvals (COAs) of the EIA for the project.	

Table 14-2: List of information to be included in Mine Closure Plan

No.	Provisions	Notes
Mine background		
1.	Location and extent of ML/PML area and the present land use pattern	
2.	Method of mining and mineral processing operations	
3.	The names and addresses of the applicant.	
4.	The qualified person who prepared the Mine Closure Plan.	
Reasons for closure		
1.	To specify reasons for closure of the mining operations in relation to exhaustion of mineral, lack of demand, uneconomic operations, natural calamity, directives from statutory organisation or court etc.	
Statutory obligation		
1.	The legal obligations, if any which the ML/PML holder is bound to implement like special conditions imposed by the authorities, EIA COAs, etc.	
Geology		
1.	Brief description of the topography and general geology indicating rock types available.	
2.	Chemical constituents of the rocks / minerals including toxic elements if any, at the mine site.	
Reserves		
1.	Indicate the existing available mineral reserves within the ML/PML.	
2.	Mineral reserve in the last approved OMS.	
3.	Balance of mineral reserves at the proposed mine closure.	
Mining method		
1.	Describe in brief the mining method used to win the mineral.	
2.	Mining machinery and equipment deployed, production level etc.	
Mineral processing		
1.	Describe in brief the mineral processing practice if any indicating the process description in short.	
2.	Indicate discharge details.	
Progressive mitigation plan		
1.	Indicate in detail the various proposals committed with special emphasis on the proposals for protection of environment in the approved OMS including the Progressive Mitigation Plan up to the closure of mine.	
2.	Highlight the areas, which might have been contaminated by mining activities and type of contaminants that might be found there.	
3.	The reasons for deviation from the proposals if any with corrective measures taken should also be given.	

Table 14-2: List of information to be included in Mine Closure Plan (Continued)

No.	Provisions	Notes
Mined-out land		
1.	Describe the proposals to be implemented for rehabilitation of mined-out land including the manner in which the actual site will be restored for future use.	
2.	The proposals should be supported with relevant plans and sections depicting the method of land rehabilitation.	
Water quality management		
1.	Describe in detail the existing surface and ground water bodies available in the ML/PML areas.	
2.	The measures to be taken for protection of the same including control of erosion, sedimentation, siltation, water treatment, diversion of water courses, if any, measures for protection of contamination of ground water from leaching etc.	
3.	Quantity and quality of surface water bodies should also be indicated and corrective measures proposed to meet the water quality conforming the permissible limits should also be described.	
4.	Report of hydrological study carried out in the area may also be submitted. The water balance chart should be given. If there is potential of Acid Mine Drainage the treatment method should be given.	
Air quality management		
1.	Describe the existing air quality status.	
2.	The corrective measures to be taken for prevention of pollution of air should be described.	
3.	Describe the type, quality and quantity of mineral reject etc. available and their disposal practice.	
Waste management		
1.	If no utilization of waste material is proposed, the manner in which the waste material will be stabilized should be described.	
2.	The protective measures to be taken for the prevention of siltation, erosion and dust generation from these waste materials should also be described.	
3.	If toxic and hazardous elements are present in the waste material the protective measures to be taken for prevention of their dispersal in the air environment, leaching in the surface and ground water etc, should be described.	
Infrastructure		
1.	The existing mine infrastructure and amenities available in the area and their future utilisation should be evaluated on case to case basis.	
2.	If retained, the measures to be taken for their physical stability and maintenance should be described.	

Table 14-2: List of information to be included in mine closure plan (Continued)

No.	Provisions	Notes
3.	If decommissioning is proposed, dismantling and disposal of building structures, support facilities and other infrastructure to be described in connection with restoring land for further use.	
Disposal of mine machinery		
1.	The decommissioning of mining machinery and their possible post-mining utilisation, if any, to be described.	
Safety and security		
1.	Explain the safety measures implemented to prevent access to surface openings, excavations etc., and arrangements proposed during the mine abandonment plan.	
Disaster management and risk assessment		
1.	This should deal with action plan for high risk accidents like landslides, subsidence, and emergency plan proposed for quick evacuation, ameliorative measures to be taken etc.	
2.	The capability of ML/PML holder to meet such eventualities and the assistance to be required from the authorities should also be described.	
Economic repercussions of the mine closure and manpower retrenchments		
1.	Manpower retrenchment, compensation to be given, socio-economic repercussions and remedial measures consequent to the closure of mines should be described.	
2.	Number of local residents employed in the mine, status of the continuation of family occupation and scope of joining the occupation back.	
3.	Compensation given or to be given to the employees connecting with sustenance of himself and their family members.	
4.	Continued engagement of employees in the rehabilitated status of ML/PML area and any other remnant activities.	
5.	Envisaged repercussions on the expectation of the society around due to mine closure.	
Time scheduling for abandonment		
1.	To describe details of time schedule of all the proposed abandonment operations.	
2.	To describe manpower and other resources required for completion of proposed activities.	
3.	The schedule of such operations should also be supplemented by PERT (Program Evaluation and Review Technique), Gantt charts etc.	
Abandonment cost		
1.	Cost to be estimated based on the activities required for implementing the protective and rehabilitation measures	
2.	Cost to include maintenance and monitoring program.	

14.4 POST-MINING REHABILITATION

As elaborated in **Section 8.3.2**, progressive rehabilitation is part of the OMS component shall be continued and further intensified during the mine closure stage. Mine rehabilitation is one of statutory requirements which need to be complied during the entire mine life as stipulated, for large scale operation in Section 126, Mineral (Perak) Enactment 2003. The preparation of a mine rehabilitation during the mine operation phase is as elaborated in **Section 8.0** of this SOP. The post-mining rehabilitation should focus on the assessment on the status performance of the rehabilitation works which have been carried out during the entire mine life and proposed further improvements where necessary. Post-mining rehabilitation should also include, the decommissioning and dismantling process of prominent structures, and make safe remedial works within the mine with further elaboration presented in **Table 14-3**.

Table 14-3: Decommissioning and dismantling of structures and safe remedial works

No.	Subjects	Notes
ISL platform and hydrometallurgical plant		
1.	To restore the land into the original ecosystem after completion of the mining operation.	
2.	The restoration approach is to adapt measures to local conditions and to carry out the restoring work in time shall enable different ecological restoration plans being set up for each area.	
3.	To implement the ISL mining and restoring at the same time.	
4.	It is estimated that the land restoration time will be about half a year after the completion of the mining operation.	
5.	The rehabilitation of the liquid injection hole shall be carried out by backfilling after the leaching is completed.	
6.	The land utilised as site for the collection facility and the hydrometallurgy plant shall be backfilled and restored after the water environment monitoring is completed.	
7.	Land restoration shall focus on three measures: land stabilization, soil improvement, and vegetation restoration as explained in **Para 8.3.3**, **Table 8-4**.	
Make safe and decontaminate all hazardous material locations		
1.	To assess how to decontaminate hazardous material locations and deposits.	
2.	All residual hazardous materials must be deposited in officially sanctioned hazardous waste deposit sites through an appropriately appointed contractor.	
3.	The removal and disposal of significant volumes of contaminated soil may involve officially registered hazardous waste sites.	

Table 14-3: Decommissioning and dismantling of structures and safe remedial works (Continued)

No.	Subjects	Notes
Prevention and control of groundwater pollution		
1.	To carry out in-situ flushing which is the injection or infiltration of water or other aqueous solution into the abandoned ISL platform.	
2.	To carry out down gradient extraction of groundwater and elutriate, above ground treatment and discharge or re-injection.	
3.	To introduce flushing solution within the vadose zone, the saturated zone, or both.	
4.	To carry out in-situ flushing which is similar with literally soil washing, which is generally used to describe the ex-situ process of using water or other solutions and a mechanical process to remove contaminants from soil.	
5.	To carry out the water flushing exercise within 30 days from the date of the official closure of one particular leaching platform area.	

CONCLUSION AND RECOMMENDATION 15.0

NR-REEs are without question, are most interesting materials, having impressive characteristics, with potential to serve a huge variety of high tech and cutting-edge applications. The fast development of modern technologies has led to the constantly growing demand for REE. REE applications vary from green technologies to advanced electronics, fine chemicals, the oil industry, nuclear, and aerospace domains. Furthermore, REE is observed to have strategic importance, as they are utilized in military related efforts, as well in the production of renewable energy. The unique properties of REE are quoted to be second to none as currently, it has very few effective substitutes. This lack of alternative or suitable replacement, further strengthens the need for continuous REE supply.

The newly discovered NR-REE IAC deposits are currently seen to be as a new and promising mineral resource to be developed in Malaysia. The ISL mining and processing method with environmentally friendly approach is a viable option in the extraction of NR-REE from the available deposits. The proactive actions taken by the Government of Malaysia in formulating appropriate SOPs for the proposed NR-REE mining is a way forward in ensuring sustainability in the mining and processing of NR-REE in Malaysia. Congruent to that, this SOP highlights the following:

1. This SOP is dedicated for mining and processing operations of NR-REE from IAC deposits, utilizing ISL mining method, with REC as the final mine product. The available NR-REE resources and the REC are non-radioactive materials, in view of their natural radioactivity concentration levels not exceeding 1.0 Bq/g or respectively 246.5 ppm of thorium or 80.9 ppm of uranium or 10 Bq/g potassium, as prescribed under Second Schedule, Atomic Energy Licencing Regulations (Radioactive Waste Management) 2011.

2. RE is a mineral by definition under the Mineral (Perak) Enactment 2003 and Mineral Development Act 1994 and thus, need to be managed and governed accordingly together with all other relevant laws, regulations, guidelines, and SOPs.

3. IAC reserves are the emerging source of NR-REE, particularly located in sub-tropic and tropical countries, challenging the dominant of mineral type REE resources. The NR-REE IAC resources that contain a higher percentage of HREE compared to the mineral type REE resources, with much more straightforward extraction route, resulting in lower extraction costs. This compensates the relatively low REE percentage (grade) in typical IAC resources.

4. Malaysia's NR-REE IAC deposits shall be developed and mined with sustainable mining methods, producing REC as the current final product. The vision of 'Dasar Mineral Negara 2' (DMN2) and 'Kerangka Pelan Transformasi Industri Mineral Negara 2021-2030' (TIM 2021-2030) are the foundation principles, embedding sustainable development application (amongst others), signalling the nation's commitment towards the SDG in the country's mining industry.

5. The implementation of ISL requires comprehensive geological and geotechnical studies to be carried out. Such study shall reveal relevant and necessary information, relating to the hydrogeological structure of the mining areas, ore characteristics, occurrence, composition and grade, surrounding rock infiltration properties, enabling estimation of the mineral reserve. Consequently, each mine requires a dedicated ISL program based on the geological survey to ensure optimum recovery of resources could be achieved.

6. The NR-REE mine operator needs to engage directly and be heavily investing in corporate social responsibility and effective communication, education and public awareness (CEPA) efforts. This is to ensure that host communities are adequately compensated for any negative impacts and that there are, shall be, net positive benefits from the development. Social Licence to Operate (SLO) in mining industry is an unofficial approval (and blessing) by the local community for the operator to proceed with the mining development.

7. In order to maintain high technical competencies in the mining and processing of NR-REE, it is important for the industry to have and foster core competencies for technical professionals in various positions of their activities at various stages of development and operation.

This SOP has taken into consideration all the above stated perspectives and as a way forward, the following points are proposed:

1. The practice of ISL mining in the past has also revealed environmental issues which need to be adequately mitigated particularly on groundwater contaminations, mine collapses and landslides. Ammonium sulphate contamination in the groundwater is of major concern.

2. The rehabilitation of completed ISL NR-REE IAC mines shall be conducted on a case-by-case basis, in line with good rehabilitation practices and standards.

3. The authority may consider tax benefits, compensation policies, regulations and support to encourage responsible and professional ISL NR-REE mining in Malaysia.

4. Both mining of NR-REE IAC deposits and the ISL recovery method are new in Malaysia. Development in various management and technical details are progressing. In view that, this

SOP is a living document, it shall need to be reviewed progressively to accommodate improvements and any changes required in the future.

In line with the 'Blueprint for the Establishment of Rare Earth-Based Industries in Malaysia, A Strategic New Source for Economic Growth – Summary for Policy Makers' (ASM 2014), the proposed mining and processing of NR-REE IAC deposit in Malaysia with REC as the final product should be seen as a beginning. Further relevant policies should be crafted, and practical technology should be sought to enable complete involvement of Malaysia in the industry. With the right policies and technologies, Malaysia should one day, be able to asses, mine, concentrate, extract, separate, purify and market individual REE with a full-fledged NR-REE processing plant and products.

Malaysia needs to achieve a centralized management of NR-REE resources by eliminating possible illegal mining, consolidating NR-REE mining operations, establishing production scale threshold for IAC NR-REE mining operations, and to set production caps. Last but not least, the country should also aim at coordinating, overseeing and regulating the development of NR-REE industry in a sustainable manner, while protecting the environment.

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APPENDICES

Appendix 1-1

GENERAL OVERVIEW OF RARE EARTH ELEMENTS

GENERAL OVERVIEW OF RARE EARTH ELEMENTS

APPENDIX 1-1

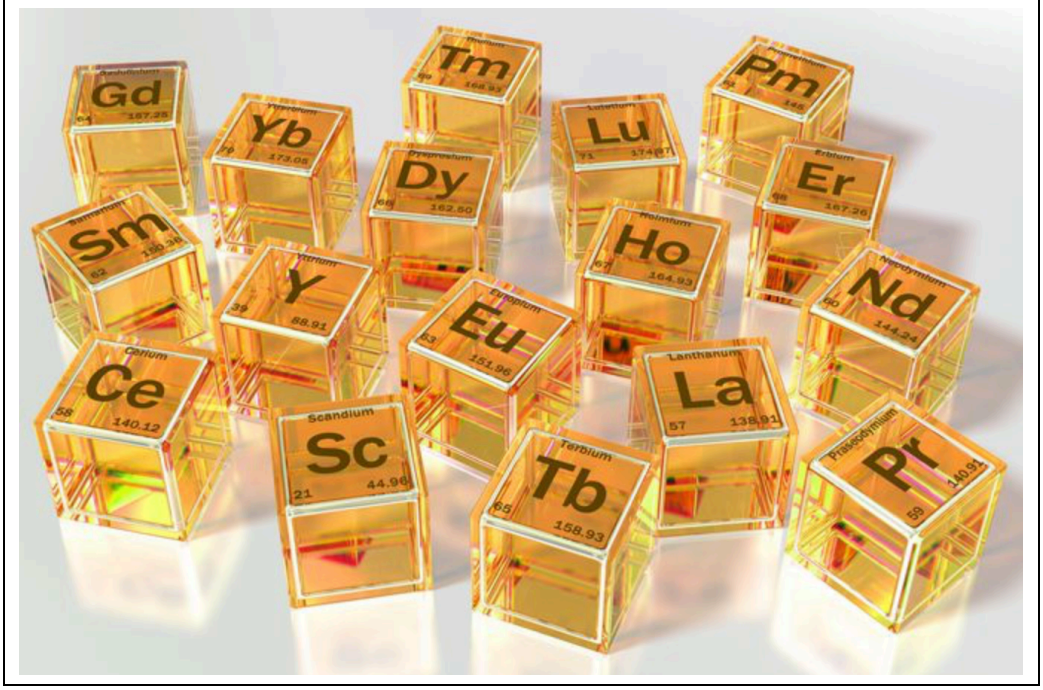
1.0 INTRODUCTION

Rare Earth Elements (REEs) are a body of 17 elements composed of the lanthanide group, atomic numbers (57–71), along with scandium (Sc, 21) and yttrium (Y, 39) as illustrated in **Figure 1**. REEs are typically grouped in 2 different categories: light rare earth elements (LREEs, atomic numbers 57–63), and heavy rare earth elements (HREEs, atomic numbers 64–71 plus yttrium 39). While it is included with the REEs, scandium does not fall into the category of LREEs or HREEs (Jordens et al., 2013). Due to their unique physical and chemical properties, REEs find wide applications in electronic, optical, magnetic and catalytic products.

Continuous development of advanced technologies has created increasing demand for REE, with global emphasis on identifying new alternate sources to ensure adequate supply. Ore deposits containing physically adsorbed lanthanides are substantially lower grade than other REE deposit types; however, the low mining and processing costs make them, Ion-Adsorption REE ore economically attractive as sources of REE.

2.0 RARE EARTH PRODUCTS

Rare Earths were first discovered in 1788. However, global annual REE production and consumption was less than 5,000 MTs of REE oxides before the 1950s and, until the 1960s, they were even rarely used in our daily life. Since the 1960s, REE applications gradually have expanded to everyday life, such as television screens, the petroleum industry, and computer systems; therefore, the global REE production and consumption have seen a significant increase in the following decades. REE are now widely used in auto and fluid catalysts, metallurgy, medical systems, high technology, clean energy, and military defense systems, and they are especially indispensable in emerging clean technologies, such as wind power turbines, electric vehicles, energy-efficient lighting, and catalytic converters. The total value of worldwide products containing REE is at least USD1.5 - USD2.0 trillion, which comprised nearly 5% of the global total gross national product in 2009.



Source: Helmenstine (2019)

Figure 1: Rare Earth 17 Elements

A significant shift from traditional energy sources towards clean energy, such as electric vehicles, is occurring; wind turbines are becoming recognized on a global scale. This transition will lead to a continuous increase in demand for REE in the coming decades and such an increasing demand puts forward a higher request for global production of REE and requires a steady supply chain in the long run. Main application of REE elements are as shown in **Table 1** with the usage of Light and Heavy REE shown in **Table 2** and **Figure 2**. Some of the RE elements are as shown in **Plate 1**. The global demand proportion on the usage of REE is depicted in **Figure 3**.

Table 1: Main Application of REEs

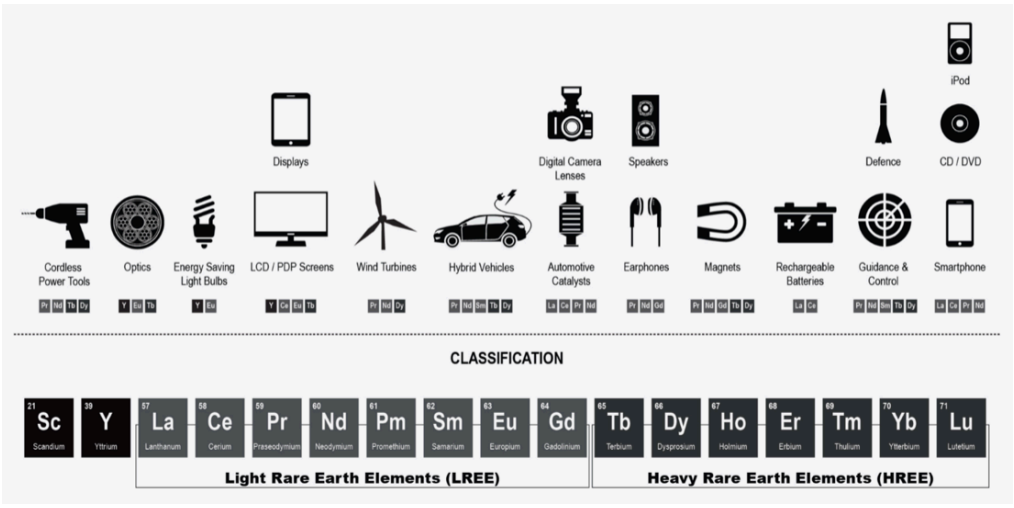
Element	Atomic No.	Application
Lanthanum	57	Electron microscopic tracer, studio lighting, laptop batteries, camera lenses and hybrid car batteries
Cerium	58	Carbon-arc lighting, TV colour, screen, fluorescent lighting. catalytic converter
Praseodymium	59	Nickel metal hydride (NiMH) in hybrid cars, glass goggles for glass blowers and welders, high-intensity carbon arc lights
Neodymium	60	NIB magnets (computers, hand phones, medical equipment, motors, wind turbines and audio systems), specialized goggles for glass blowers.

Element	Atomic No.	Application
Samarium	62	Magnets for headphones, small motors and pickups for some electric guitars, absorber in nuclear reactors, cancer treatment.
Europium	63	Anti-forgery marks on euro bank notes, nuclear reactor control rods, compact fluorescent bulbs
Gadolinium	64	Microwave, MRI, colour television picture tubes
Terbium	65	Magnet for wind turbine and hybrid car motor, speaker UV light for euro bank notes
Dysprosium	66	Speakers, compact discs and hard discs, medium source rare-earth lamps (MSRs) within the film industry
Holmium	67	Yellow or red colouring for glass, cubic zirconia, nuclear reactor control rods, solid-state lasers for non-invasive medical procedures treating cancers and kidney stones.
Erbium	68	Nuclear reactor control rods, coloring agent in glazes and glasses. Laser for skin (remove tattoo)
Thulium	69	Laser, euro banknotes for its blue fluorescence under UV

Table 2: Light and Heavy Rare Earth Elements and their Usage

Elements		Usage				
		Catalyst	Glass Polish	Magnets	Lasers	Others
Light Rare Earth						
La	57	•	•			H_2 Storage, Batteries, Camera Lenses, Flint
Ce	58	•	•			Ceramics
Pr	59		•	•	•	Ceramics, Lighting, Flint
Nd	60		•	•	•	Ceramic Capacitors
Sm	62			•	•	Neutron Capture, Masers
Eu	63	•			•	Mercury-Vapour Lamps
Heavy Rare Earth						
Gd	64		•	•	•	X-Ray Tube, Computer Memory, Neutron Capture
Tb	65			•	•	Fluorescent Lamps
Dy	66			•	•	
Ho	67				•	
Er	68				•	Vanadium Steel
Tm	69				•	Portable X-Ray Machines
Yb	70					Reducing Agent
Lu	71		•			PET Scan Detectors
Y	39				•	Superconductors, Microwave Filter

Source: Krishnamurthy (2006)



Source: China Water Risk (2016)

Figure 2: Rare Earth Applications

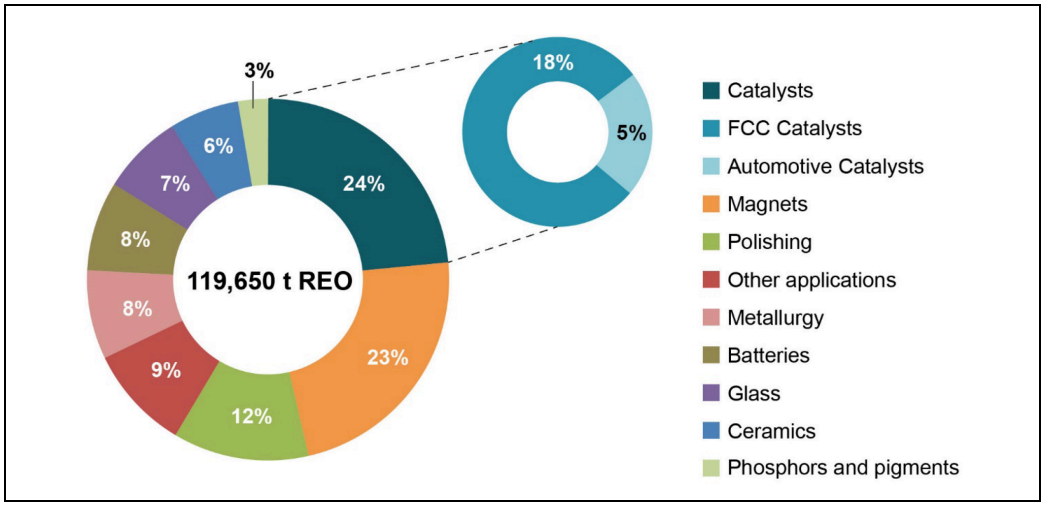
Source: US Department of Agriculture / Peggy Greb (2019)

Plate 1: Rare Earth Metals, Clockwise from Top Center – Praseodymium, Cerium, Lanthanum, Neodymium, Samarium and Gadolinium

3.0 RARE EARTH PRICES

Global Rare Earth metals market is projected to reach USD 14.43 billion by 2025. The best prospects are forecast for the permanent magnets segment, boosted by expanding

production of advanced neodymium magnets for applications such as wind turbines and hybrid and electric vehicles (H/EVs). Growing output of nickel-metal hydride (Ni-MH) batteries is also expected to boost rare earths consumption, although strong competition from sales of lithium-ion batteries will prevent faster market expansion. In addition, upgrades to oil refining sectors in emerging countries are projected to fuel global catalytic cracking capacity, supporting the production of fluid cracking catalysts and associated demand for lanthanum and cerium. Among other major markets, rising production of steel, motor vehicles, and electronics is expected to stimulate the consumption of rare earths. Ongoing weakness in rare earth prices is also expected to bolster demand volumes, promoting a shift back to rare earth-based catalysts, polishing powders, and other products that manufacturers abandoned amid the 2010 - 2012 price spike. Nevertheless, lingering wariness of price volatility will support the continued usage of alternative low and zero rare earth products, limiting stronger market advances through 2020. The current price of Rare Earth is as shown in **Table 3**. However, it needs to be emphasized here that the final product of the proposed mine is RE Carbonate with the average price of about RM12,865 per MT.



Source: Roskill (2016)

Figure 3: Global Rare Earth Usage Proportions

Table 3: Rare Earth Price Ranges

Rare Earth (RE)	Price / MT			
	Range		Average	
	RMB	RM	RMB	RM
Concentrate (9/10/2020) (RMB 1.00 = RM 0.62)				
RE Carbonate	15,500 - 22,000	9,610 - 13,640	20,750	12,865
Oxides (9/10/2020) (RMB 1.00 = RM 0.62)				
Lanthanum Oxide	9,000 - 9,500	5,580 - 5,890	9,250	5,735

Rare Earth (RE)	Price / MT			
	Range		Average	
	RMB	RM	RMB	RM
Cerium Oxide	9,000 - 9,500	5,580 - 5,890	9,250	5,735
Praseodymium Oxide	320,000 - 325,500	198,400 - 201,500	322,500	199,950
Neodymium Oxide	346,000 - 352,000	214,520 - 218,240	349,000	216,380
Samarium Oxide	11,000 - 12,000	6,820 - 7,440	11,500	7,130
Europium Oxide	195,000 - 215,000	121,000 - 133,000	205,000	127,000
Gadolinium Oxide	172,000 - 176,000	106,640 - 109,120	174,000	107,880
Terbium Oxide	4.800 - 4.850 mil	2.976 - 3.007 mil	4,825,000	2,992,000
Dysprosium Oxide	1.670 - 1.690 mil	1.035 - 1.048 mil	1,680,000	1,042,000
Erbium Oxide	156,000 - 161,000	96,720 - 99,820	158,500	98,270
Yttrium Oxide	18,000 - 19,500	11,160 - 12,090	18,500	11,470
NdPr oxide	324,000 - 328,000	200,880 - 203,360	326,000	202,120
Holmium oxide	416,000 - 420,000	257,920 - 260,400	418,000	259,160
RE Metal (9/10/2020)				
Lanthanum	28,000 - 29,000	17,360 - 17,980	28,500	17,670
Cerium	27,000 - 28,000	16,740 - 17,360	27,500	17,050
Praseodymium	670,000 - 680,000	415,400 - 421,600	675,000	418,500
Neodymium	436,000 - 440,000	270,320 - 272,800	438,000	271,560
Terbium	6.150 - 6.200 mil	3.813 - 3.844 mil	6,175,000	3,829,000
Dysprosium	2.160 - 2.200 mil	1.339 - 1.364 mil	2,180,000	1,352,000
Yttrium	215,000 - 225,000	133,300 - 139,500	220,000	136,400
Cerium Misch	27,000 - 29,000	16,740 - 17,980	28,000	17,360
Lanth Cerium Metal	28,000 - 30,000	17,360 - 18,600	29,000	17,980
Pr-Nd Alloy	412,000 - 418,000	255,400 - 259,160	415,000	257,300
Battery Grade Misch	140,000 - 150,000	86,800 - 93,000	145,000	89,900
Dy-Iron Alloy	1.660 - 1.689 mil	1,029 -1,048 mil	1,670,000	1,035,400
Holmium Ferroalloy	430,000 - 435,000	266,600 - 269,700	432,500	268,150

Source: SMM PRICE – price.metal.com (2020)

The average price range for various RE element oxide products as shown are between RM 7,130 and RM 2.992 million per MT, while for RE metals are between RM17,050 and RM 3.829 million per MT. Growth will be driven by expanding production of advanced neodymium magnets, rising output of nickel-metal hydride batteries, and oil refining upgrades in emerging countries that will require fluid cracking catalysts. World demand to rise 3.5% annually through 2019. Another price ranges in recent years compiled by USGS is shown in **Table 4**.

Table 4: Rare Earth Price Ranges (USGS)

Rare Earth	Grade	Price/MT (USD)				
		2014	2015	2016	2017	2018
Cerium Oxide	99.5% minimum	5,000	3,000	2,000	2,000	2,000
Dysprosium Oxide	99.5% minimum	395,000	279,000	395,000	279,000	180,000
Europium Oxide	99.5% minimum	822,000	344,000	74,000	77,000	56,000
Lanthanum Oxide	99.5% minimum	5,000	3,000	2,000	2,000	2,000
Mischmetal	65% Ce, 35% La	10,000	7,000	5,000	6,000	6,000
Neodymium Oxide	99.5% minimum	63,000	48,000	40,000	50,000	51,000
Terbium Oxide	99.5% minimum	713,000	564,000	415,000	501,000	461,000

Source: Argus Media group – Argus Metals International, USGS (2019)

4.0 RARE EARTH MARKET

The global market for rare earth metals demonstrates a fragmented business landscape. Molycorp, Chinalco Yunnan Copper Resources Ltd., Great Western Minerals Group, Inner Mongolia Baotou Steel Rare-Earth Hi-Tech Co., Alkane Resources, Rare Elements Resources Ltd., Greenland Rare Earth and Energy Ltd., Arafura Resources, China Rare Earth Holdings, Lynas Corp. Ltd., Indian Rare Earths, and Avalon Rare Metals are some of the key players in this market. The market is becoming increasingly competitive due to the constant entry of new companies. Researchers expect the competition within this market to intensify in the years to come, notes the market study.

According to the research report, the worldwide market for rare earth metals, which stood at USD 3.9 billion in 2012, has been projected to rise at a CAGR of 13.0% during the period from 2012 to 2018 and increase to USD 8.1 billion by the end of the period of the forecast. Among all the types of products available in this market, cerium oxide is the most-valued one. However, the sales of lanthanum oxide is also expected to increase significantly in the near future, thanks to its augmenting usage in various industries, such as construction, green technology, electronics, and automotive, states the research report.

In terms of the geography, Europe, Asia Pacific, North America, and the rest of the world have surfaced as the key segments in the global market for rare earth metals. With extremely concentrated reserves of rare earth metals, this market witnesses robust progress in only a few parts across the world. Asia Pacific, by far, has been leading the worldwide rare earth metals market, with China being the most prominent one. Thanks to the gigantic reserves of rare earth metals in this country, nearly 95.0% of the overall production of rare earth metals around the world is carried out in China. Not just the production but also the consumption of rare earth metals is considerably high in this

country, which ensures its future dominance. The US, India, Russia, and Australia are expected to closely follow China in the years to come, reports the research study.

Appendix 1-2

NON-RADIOACTIVE RARE EARTH ELEMENTS
(NR-REE)

NON-RADIOACTIVE RARE EARTH ELEMENTS (NR-REE)

APPENDIX 1-2

1.0 INTRODUCTION

Rare Earth Elements (REE) are considered to be critical raw materials due to the combination of their high importance in a range of low-carbon technologies and the concentration of supply, which is dominated by China. The REE industry has a legacy of severe environmental impacts in its footprints related to the mining, beneficiation, and cracking process. The beneficiation process particularly from the mineral type REE has generated radioactive contaminated wastes which has in the past create legal and environmental issues with the authorities and the local community.

Continuous development of advanced technologies has created increasing demand for REE, with global emphasis on identifying new alternate sources to ensure adequate supply. Ore deposits containing physically adsorbed lanthanides are substantially lower grade than other REE deposit types; however, the low mining and processing costs make them, Ion-Adsorption REE ore economically attractive as sources of REE. Ion-Adsorption Clay deposit is currently the focus source of REE in Malaysia. It is a new promising mineral resource with potentials as new economics for Malaysia. It is a non-radioactive source of Rare Earth Elements (NR-REE), mineable using sustainable mining method with RE Carbonate as the final product.

In-Situ Leaching (ISL) mining method has been identified as the sustainable mining approach to be utilized for the extraction and processing of the available deposits. As of now, in consideration of the technology, currently available locally, the final mining product shall be RE Carbonate. The REE concentrates shall be exported for further processing into various 16 individual RE elements. With the progress in various exploration programs currently undertaken, it is expected that by 2022, the nation shall witness the first production of RE Carbonate from NR-REE mine in the country.

2.0 REE GEOLOGY AND DEPOSITS

REE are not found as native metals, but rather are found in a range of minerals including silicates, carbonates, oxides, phosphates, and halides. REE are not major rock forming elements, rather there are processes that concentrate specific REE distributions in

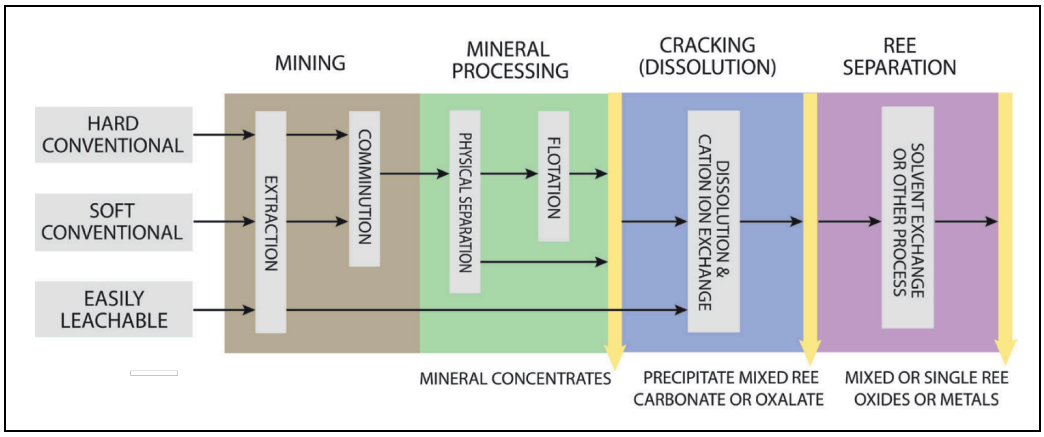
residual fluids and are considered accessory minerals (Wall, 2014). The geology of REE deposits ranges from carbonatite-related deposits such as fresh rocks and laterite, alkaline syenties and granites, weathered silicate rocks with REE ion adsorption clays (Orris and Grauch, 2002, Wall, 2014, Haque et al., 2014). There are also hydrothermal deposits, marine, and by-product of placers, bauxite production and waste, and phosphate production for fertiliser (Wall, 2014).

There are over 200 identified REE-bearing minerals (Goodenough et al., 2016), and it is common for a handful of new REE minerals to be discovered each year (Chakhmouradian and Wall, 2012). Most REE-bearing minerals are rare, the more common bastnasite, monazite, and xenotime are considered the principal ore minerals and if the Ion-Adsorption Clay deposits are included, these deposit types account for 95% of world production (Krishnamurthy and Gupta, 2015). Most natural REE minerals are dominated by La, Ce, and Nd with a lower amount of HREE (Goodenough et al., 2017). Monazite, a phosphate mineral with the typical formula [(Ce, La, Y, Th)PO_4], always contains additions of other LREEs.

3.0 REE MINING, MINERAL PROCESSING, AND METALLURGY

REE deposits are unique, with a unique combination of minerals. For example Bayan Obo, which is the largest REE mine in production contains bastnasite, monazite, fluorite, magnetite, barite, dolomite, aegirine, calcite, quartz (Fan et al., 2016). There are no REE projects around the world which have identical mining stages and process flowsheets due to the distinct nature of REE deposits and mineralogy but there are common process flow stages that are shared by a number of projects. These stages include mining from the ore deposits, crushing and grinding the ore, cracking the minerals to produce mixed REO concentrates, before separation and purification of the oxide concentrates as depicted in **Figure 1**. Only three major REE bearing minerals are exploited commercially; Bastnasite, Monazite, and Xenotime, plus the addition of Ion-Adsportion Clays.

The REE production chain is complex and often involves a number of stakeholders but can be divided by 4 phases: mining, mineral processing, cracking, and REE separation. Not all of these stages will be on-site and may be in different countries entirely. REE are sold in various forms, including as mineral concentrates, as mixed Rare Earth Oxides (REO), individual oxides, carbonates, purified metals, or metal mixtures as shown in **Figure 1**. A single operation may produce a number of different saleable products in these formats. **Plate 1** to **Plate 3** show some of these products.



Source: Wall et al. (2017)

Figure 1: Summary of Mining and Processing Routes for REE Deposits. Ion-Adsorption Clay is Under the Easily Leachable REE Deposit Type

Plate 1: Intermediate REE Product – RE Carbonate, Final Mine Product for Further Processing into REE Oxide and Crack into 16 REE at Guangxi Rare Earth, a Unit of Chinalco Rare Earth & Metals Co. Ltd.

In summary, REE can be extracted by 2 processes, that are (1) The extraction of REE from minerals such as bastnasite, monazite and xenotime. In Malaysia, monazite and xenotime are heavy minerals by-products of tin industry, locally known as amang; and (2) Extraction of REE from Ion-Adsorption Clay deposits, resulting from geologically, in-situ weathering of host rocks (mainly granitic). This method is known as non-radioactive rare

elements (NR-REE) mining and processing. **Table 1** summarizes the comparison of both operations.

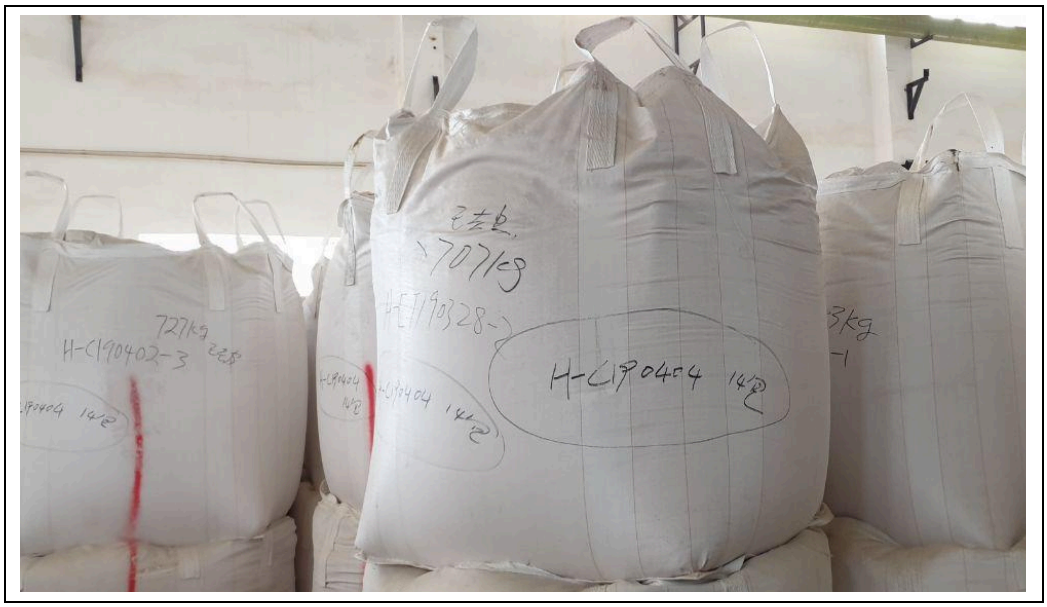


Plate 2: Intermediate REE Product – RE Carbonate, Packed in Jumbo Bags and Send for Processing at Guangxi Rare Earth, a Unit of Chinalco Rare Earth & Metals Co. Ltd.

Plate 3: Intermediate REE Product – RE Oxide for Further Processing to Crack into 16 Elements of RE, Final Product of Ion-Adsorption RE Clay Deposit, Produced at Guangxi Rare Earth, a Unit of Chinalco Rare Earth & Metals Co. Ltd.

Table 1: Comparison of REE Production (Deposits and Operation)

REE (Extracted from Ion-Adsorption Clay)	REE (Extracted from Monazite, Xenotime, Bastnasite)	
	ARE and MAREC*	Lynas Malaysia Sdn. Bhd.
In-Situ Leaching (ISL) mining and RE Carbonate processing. RE Carbonate as final product for export	Processing monazite from Monazite from BEH Minerals to extract yttrium, the REE. Generated wastes contaminated with radioactive, thorium and uranium	RE refining facility to produce individual Rare Earth elements or mixtures of elements for selected Industries application
Export RE Carbonate to China for processing	Produced yttrium	Import bastnasite concentrate from Australia
Produce scheduled wastes and no radioactive residue	Produce radioactive residue and scheduled wastes	Produce radioactive residue and scheduled wastes

*Note: ARE - Asian Rare Earth; MAREC - Malaysian Rare Earth Corporation

4.0 ION-ADSORPTION RARE EARTH ORE

Type of REE ore of interest today is Ion-Adsorption REE ore, which are geologically available in Malaysia. Weathered crust elution-deposited REE ores (Ion-Adsorption ores) are aluminosilicate minerals (e.g. kaolinite, illite and smectite) containing 0.05–0.3 wt.% REEs physically adsorbed at sites of permanent negative charge (Chi and Tian, 2008). The Ion-Adsorption Clay deposits are the result of In-Situ weathering of host rocks (mainly granitic), which, over geological timescales, results in the formation of aluminosilicate clays. Clay minerals are part of the phyllosilicate class, containing layered structures of shared octahedral aluminium and tetrahedral silicon sheets, allowing water molecules and hydrated cations to move in and out of the interlayer spaces (Velde and Meunier, 2008). Very commonly, isomorphous substitution of one cation with another (of similar size but with lesser charge, e.g. Al^{3+} for Si^{4+} or Mg^{2+} for Al^{3+}) within crystal structures leads to a charge imbalance in silicate clays, which accounts for the permanent negative charge on clay particles, and thus the capability of adsorbing REE ions released/dissolved from precursor REE-bearing minerals during weathering. Warm tropical and sub-tropical climates present ideal conditions for this process to occur (Sanematsu et al., 2013).

Ion-Adsorption Clays have different REE content from that of bastnasite and monazite. For Ion-Adsorption Clays REE distribution varies significantly from location to location, but seem to have much higher content of some highly valuable HREEs than bastnasite

and monazite as typically shown in **Table 2**. In addition, as the name implies, REEs present in Ion-Adsorption Clays are in the form of trivalent cations adsorbed on kaolin, which brings the relative ease of extraction (i.e., near the surface and unconsolidated). Due to these reasons, Ion-Adsorption Clays represent an important source of REEs, especially HREEs (Chakhmouradian and Wall,2012; Walters et al., 2011). In fact, approximately 35% of Chinese production of REEs is coming from Ion-Adsorption Clays (Papangelakis and Moldoveanu, 2014; Yang et al., 2013).

Ion-Adsorption Clay type deposits are substantially lower grade than other types of REE sources, nominally requiring higher costs for REE extraction and recovery. However, this disadvantage is largely offset by the easier mining and processing costs, and the relatively low content of radioactive elements such as thorium and uranium. These deposits are mined by In-Situ Leaching mining method and no ore processing is required. A simple leach using monovalent sulfate or chloride salt solutions at ambient temperature can produce a high-grade RE Carbonate product. Because of their abundance in surface layers in nature, ease of mining and processing, these clays warrant a detailed study as important sources of REEs. In addition, radioactive elements in clay deposits are depleted away during the weathering, and as a result, the adverse effects of radioactive contaminants in these deposits are minimized.

The Ion-Adsorption ores contain clays with permanent negative surface charge, which is responsible for cation (such as REE) adsorption via electrostatic bonds. Research shows that for acidic and near-neutral conditions (pH < 6.5 – 6.8), most of the surface-adsorbed extractable REEs occur as simple or hydrated cations such as ‘clay- REE’ or ‘clay-REE $(H_2O)_n$’ species derived from straight- forward cation-exchange reversible reactions at the permanent negative charge sites on the clays (physisorption); for pH > 7 the prevalent forms are the irreversibly-fixed hydrolyzed ‘clay-O-REE^{2+}’ species derived from permanent complexation reactions at the amphoteric surface hydroxyl groups (chemisorption).

5.0 NON-RADIOACTIVE RARE EARTH ELEMENTS (NR-REE)

All minerals and raw materials contain radionuclides of natural origin, of which the most important for the purposes of radiation protection are the radionuclides in the U-238 and Th-232 decay series and K-40. For most human activities involving minerals and raw materials, the levels of exposure to these radionuclides are not significantly greater than normal background levels. Such exposures, while having been the subject of much research, are not of concern for radiation protection.

Table 2: Typical Components of the Ion-Adsorption Clay Deposit (Malaysia)

Atomic No.	Element	Symbol	Classification	Ranges of REE Proportion (Typical Examples)					
				Borehole 1		Borehole 2		Borehole 3	
				PPM	%	PPM	%	PPM	%
57	Lanthanum	La	Light Rare Earths	65.49	23.63	122.06	23.62	137.16	32.41
58	Cerium	Ce		12.14	4.38	19.43	3.76	0.68	0.16
59	Praseodymium	Pr		15.85	5.72	32.14	6.22	30.85	7.29
60	Neodymium	Nd		63.55	22.93	127.53	24.68	130.68	30.88
61	Promethium	Pm							
62	Samarium	Sm		12.14	4.38	20.46	3.96	22.51	5.32
63	Europium	Eu		2.05	0.74	3.77	0.73	3.30	0.78
64	Gadolinium	Gd	Heavy Rare Earths	10.57	3.81	16.28	3.15	14.61	3.43
65	Terbium	Tb		1.30	0.47	2.38	0.46	1.91	0.45
66	Dysprosium	Dy		9.40	3.39	16.07	3.11	9.86	2.33
67	Holmium	Ho		2.11	0.76	3.98	0.77	1.99	0.47
68	Erbium	Er		5.88	2.12	13.02	2.52	5.16	1.22
69	Thulium	Tm		0.94	0.34	1.55	0.30	0.76	0.18
70	Ytterbium	Yb		5.88	2.12	10.75	2.08	4.49	1.06
71	Lutetium	Lu		0.83	0.30	1.45	0.28	0.59	0.14
39	Yttrium	Y		69.04	24.91	125.88	24.36	58.74	13.88
				277.12	100.00	516.75	100.00	423.19	100.00
21	Scandium	Sc	Unclassified						

Minerals, like clay, mostly contain natural radionuclides from terrestrial origin, which are commonly referred as primordial radionuclides. Accordingly, it is also known as Naturally Occurring Radioactive Materials (NORM). There are over 50 occurring naturally radioactive elements, but the elements of main concern in radiometric studies are uranium (U-238), thorium (Th-232T), and potassium (K-40). The latter is common in potassium-rich rocks that cannot be related to concentrations of U and Th.

5.1 Staturory Requirements

Naturally Occurring Radioactive Materials (NORM) is a radioactive material in its natural state containing no significant amounts of radionuclides other than naturally occurring radionuclides. NORM are present in all geological related materials. The activity concentrations of NORM vary widely and typically low in clay and higher in granite. The law of Malaysia with respect to the use and control of all sources of ionizing radiation, whether artificial or man-made is prescribed in the Atomic Energy Licensing Act, 1984 and its subsidiary legislations.

NORM is control as radioactive materials in Malaysia. The control limit is 1 Bq/g for radionuclide of Th-232 and U-238, and 10 Bq/g for the K-40. The equivalent control limit in ppm is 246.5 ppm for Th and 80.9 ppm for U. Any material contain NORM exceeding these limits, as prescribed under Second Schedule, Atomic Energy Licencing Regulations (Radioactive Waste Management) 2011 is radioactive material.

A guideline published by AELB, 'Panduan Penentuan Perlesenan Aktiviti Melibatkan Bahan Radioaktif Semulajadi [Naturally Occurring Radioactive Material (NORM)] under Atomic Energy Licensing Act 1984 should be referred in determining whether any material containing NORM exceeded the stipulated limits.

In Malaysia, the Atomic Energy Licensing Board (AELB) is the authority established under Section 3 of the Atomic Energy Licensing Act 1984 to control and supervise the radioactive waste management in Malaysia, including the potential radioactivity harm to human and the environment.

5.2 NR-REE Ion Adsorption Clay

A preliminary radioactivity level analysis has been conducted at one of the proposed REE mine in Malaysia to gauge the natural radioactivity level of the soil at the site. From the analysis, different elements have been tested including Ra-226, Ra-228, K-40, Th-228, Th-230, Th-232, U-234, U-235 and U-238. The level of radioactivity is low, lower than 1.0 Bq/g except for K-40 (around 1.1 Bq/g). The test report is appended in **Attachment 1**.

With the low radioactivity, detailed Radioactive Impact Assessment is not required in the mining and processing of the REE Ion-Adsorption clay deposits. However, sample analysis for soil, water and the final mine products are necessary to be conducted. It is also highly recommended to project the increment level of radioactivity of the Ion-Adsorption RE clay deposit upon the concentration process.

The AELB service or other accredited laboratory may be engaged for sampling and radiochemistry testing. Suitable analytical options for the determination of radioactive constituent in groundwater, produced water, soil and solid waste should be used. Experts are expected to assist in determining the best technical approach to meet the project data needs.

5.3 NORM Monitoring

The production of RE Carbonate, the final product of the Ion-Adsorption In-Situ Leaching Mining and beneficiation is not a radioactive material. The operation is not likely to generate waste or residual containing radioactive. Nevertheless, as part of comprehensive environmental monitoring at the project site, baseline and later during the operational stage, radiochemistry testing on Naturally Occurring Radioactive Material (NORM) shall be carried out. NORM is found everywhere and as these materials are found in the natural environment, NORM is often exempted from regulation.

The NORM with which the project deals, that is the RE Carbonate is within a safe background level. No radioactive contaminated waste shall be generated from the ISL mining operation and the processing of the Ion-Adsorption Clay. The national and international Annual Dose Limit for the public is 1mSv/ year with the project area radiation exposure to the public is about 0.002mSv/year.

Baseline for the NORM quality sampling should be established at appropriate monitoring stations. The parameters to be tested are Ra-226, Ra-228, K-40, Th-228, Th-230, Th-232, U-234, U-235 and U-238 and the tests shall use appropriate Standard Test Methods. Test results of the monitoring should be discussed in the reporting to be submitted to the relevant authorities with comparison made with the relevant Quality Standards for Malaysia.

Attachment 1

Radioactivity Concentration Levels of Material Samples Collected Within the Project Site

MALAYSIAN NUCLEAR AGENCY (NUKLEAR MALAYSIA)
MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION
BANGI, 43000 KAJANG, SELANGOR DARUL EHSAN
Tel: +603-8911 2000/2130 Fax: +603-8928 2977 Email: radiokimia@nm.gov.my
http://www.nuclearmalaysia.gov.my

SAMM 315

RADIOACTIVITY ANALYSIS REPORT

Reference No:	RAS/ES 0381 – 0382 - 01/2020 NM/KHID/19JLD59(62)	**Date of Issue**: February 03, 2021
Agency Name:	Aras Kuasa Sdn. Bhd., Level 8 Menara Zenith, Jalan Putra Square 6, Putra Square, 25200 Kuantan, Pahang.	
Sample: **Analysis Technique:** **Date of Analysis :**	Soil. In-house Method, RAS–TM–01 20 & 22 May 2020	

No.	Sample Type/Description	Radioactivity Level (Bq/kg)		
		Ra-226	Ra-228	K-40
	SOIL			
1.	P1761 – 1	390 ± 49	290 ± 47	800 ± 120
2.	P1761 – 2	340 ± 42	250 ± 39	920 ± 130

Note:

i) Results reported at 95% level of confidence.
ii) These results are only valid for the analyzed sample only.
iii) '<' Minimum Detectable Activity value reported.
iv) Opinions and interpretations expressed herein are outside the scope of SAMM accreditation.
v) This report shall not be reproduced except in full, without written approval of the laboratory.
vi) This report is to replace the previous report with serial **No. ES/01-20200605**

Prepared By:

.....

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MALAYSIAN NUCLEAR AGENCY (NUKLEAR MALAYSIA)
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http://www.nuclearmalaysia.gov.my

MS ISO/IEC 17025
TESTING
SAMM NO. 315

Serial No.: ES/01-20200708

RADIOACTIVITY ANALYSIS REPORT

Reference No:	RAS/ES 0491 – 0493 - 01/2020 NM/KHID/19JLD57(38)	**Date of Issue**: July 14, 2020
Agency Name:	Aras Kuasa Sdn. Bhd., Level 8 Menara Zenith, Jalan Putra Square 6, Putra Square, 25200 Kuantan, Pahang.	
Sample: **Analysis Technique:**	Soil. In-house Method, RAS–TM–01	

No.	Sample Type/Description	Radioactivity Level (Bq/kg)		
		Ra-226	Ra-228	K-40
	SOIL			
1.	PT 1759 – 1	350 ± 38	290 ± 34	930 ± 110
2.	PT 1760 – 1	240 ± 26	230 ± 29	850 ± 100
3.	PT 1761 – 3	310 ± 34	220 ± 27	600 ± 75

Note:

i) Results reported at 95% level of confidence.
ii) These results are only valid for the analyzed sample only.
iii) '<' Minimum Detectable Activity value reported.
iv) Opinions and interpretations expressed herein are outside the scope of SAMM accreditation.
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RADIOACTIVITY ANALYSIS REPORT

Reference No:	RAS/FS 0150 – 0160 - 01/2021 NM/KHID/19JL D59(92)	**Date of Issue**: March 17, 2021
Agency Name:	MCRE Resources Sdn. Bhd., Level 8 Menara Zenith, Jalan Putra Square 6, Putra Square, 25200 Kuantan, Pahang.	
Sample: **Analysis Technique:** **Date of Analysis :**	Soil. In-house Method, RAS–TM–01 March 15, 2021	

No.	Sample Type/Description	Radioactivity Level (Bq/kg)		
		Ra-226	Ra-228	K-40
	SOIL			
1.	FELCRA 01	280 ± 32	430 ± 51	1000 ± 120
2.	FELCRA 02	270 ± 37	270 ± 46	360 ± 63
3.	PT1759 – 2	340 ± 35	260 ± 31	660 ± 82
4.	PT1760 – 2	450 ± 48	290 ± 35	1400 ± 160
5.	PT1760 – 3	330 ± 38	270 ± 35	1100 ± 130
6.	PT1762 – 1	120 ± 15	180 ± 23	1300 ± 150
7.	PT1762 – 2	170 ± 21	290 ± 39	1100 ± 130
8.	PT1763 – 1	180 ± 24	290 ± 45	1300 ± 190
9.	PT1763 – 2	210 ± 29	260 ± 43	770 ± 120
10.	PT1764 – 1	180 ± 25	270 ± 45	730 ± 110
11.	PT1764 – 2	230 ± 27	280 ± 38	510 ± 67

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RADIOACTIVITY ANALYSIS REPORT

Reference No:	**ARAS KUASA 110320**	Date of Issue:	**01 FEB 2021**
Agency Name:	**ARAS KUASA SDN. BHD. (660917-W)**		
Analysis Technique:	Radiochemical separation followed by direct measurement using Alpha Spectrometry System		

No.	Sample Code	Sample Type/Description	Specific Activity (Bq/kg)		
			Th-228	Th-230	Th-232
1	P1761-1	SOIL	116.37 ± 8.34	117.18 ± 8.40	74.16 ± 5.32
2	P1761-2	SOIL	60.09 ± 4.31	63.48 ± 4.55	34.44 ± 2.47

MDL – Minimum Detection Limit for counting:- Th-228 : 0.2 Bq/kg
Th-230 : 0.2 Bq/kg
Th-232 : 0.2 Bq/kg

Note:

i) The values reported are at 95% confidence level.
ii) The results are valid for the analysed samples only.
iii) '<' means Minimum Detectable Activity value reported.
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Serial No.: ES/03-20200708

RADIOACTIVITY ANALYSIS REPORT

Reference No:	**PT1759-PT1761**	Date of Issue:	**21 JULY 2020**
Agency Name:	**ARAS KUASA SDN. BHD. (660917-W)**		
Analysis Technique:	Radiochemical separation followed by direct measurement using Alpha Spectrometry System		

No.	Sample Code	Sample Type/Description	Specific Activity (Bq/kg)		
			Th-228	Th-230	Th-232
1	PT1759-1	SOIL	573.63 ± 41.09	422.66 ± 30.27	290.63 ± 20.82
2	PT1760-1	SOIL	214.26 ± 15.35	193.30 ± 13.85	101.19 ± 7.25
3	PT1761-3	SOIL	59.35 ± 4.26	50.60 ± 3.63	29.33 ± 2.11

MDL – Minimum Detection Limit for counting:- Th-228 : 0.2 Bq/kg
Th-230 : 0.2 Bq/kg
Th-232 : 0.2 Bq/kg

Note:

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RADIOACTIVITY ANALYSIS REPORT

Reference No:	**MCRE RESOURCES (180121)(Th,U)**	Date of Issue:	**01 APRIL 2021**
Agency Name:	**MCRE RESOURCES SDN. BHD. (1366182-T)**		
Analysis Technique:	Radiochemical separation followed by direct measurement using Alpha Spectrometry System		

No	Sample Code	Sample Type/Description	Specific Activity (Bq/kg)		
			Th-228	Th-230	Th-232
1	Felcra 01	SOIL	1,337.48 ± 95.79	401.45 ± 28.76	500.88 ± 35.88
2	Felcra 02	SOIL	643.36 ± 46.08	258.42 ± 18.51	234.34 ± 16.79
3	PT1759-2	SOIL	781.50 ± 55.97	414.41 ± 29.68	291.01 ± 20.85
4	PT1760-2	SOIL	786.49 ± 56.33	540.56 ± 38.72	308.89 ± 22.13
5	PT1760-3	SOIL	699.32 ± 50.09	326.28 ± 23.37	259.30 ± 18.58
6	PT1762-1	SOIL	494.46 ± 35.42	111.14 ± 7.96	194.92 ± 13.96
7	PT1762-2	SOIL	777.35 ± 55.68	169.83 ± 12.17	288.99 ± 20.70
8	PT1763-1	SOIL	878.93 ± 62.95	224.38 ± 16.07	328.24 ± 23.51
9	PT1763-2	SOIL	767.47 ± 54.97	210.50 ± 15.08	282.99 ± 20.27
10	PT1764-1	SOIL	680.99 ± 48.78	182.83 ± 13.10	252.61 ± 18.10
11	PT1764-2	SOIL	1,018.71 ± 72.96	301.63 ± 21.61	374.97 ± 26.86

MDL – Minimum Detection Limit for counting:- Th-228 : 0.2 Bq/Kg
Th-230 : 0.2 Bq/Kg
Th-232 : 0.2 Bq/Kg

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RADIOACTIVITY ANALYSIS REPORT

Reference No:	**ARAS KUASA 110320**	Date of Issue:	**01 FEB 2021**
Agency Name:	**ARAS KUASA SDN. BHD. (660917-W)**		
Analysis Technique:	Radiochemical separation followed by direct measurement using Alpha Spectrometry System		

No.	Sample Code	Sample Type/Description	Specific Activity (Bq/kg)		
			U-234	U-235	U-238
1	P1761-1	SOIL	358.81 ± 13.11	14.15 ± 0.52	374.15 ± 13.67
2	P1761-2	SOIL	460.79 ± 16.84	13.59 ± 0.50	460.10 ± 16.81

MDL – Minimum Detection Limit for counting:- U-234 : 0.2 Bq/kg
U-235 : 0.2 Bq/kg
U-238 : 0.2 Bq/kg

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Serial No.: ES/03-20200707

RADIOACTIVITY ANALYSIS REPORT

Reference No:	**PT1759-PT1761**	Date of Issue:	**21 JULY 2020**
Agency Name:	**ARAS KUASA SDN. BHD. (660917-W)**		
Analysis Technique:	Radiochemical separation followed by direct measurement using Alpha Spectrometry System		

No.	Sample Code	Sample Type/Description	Specific Activity (Bq/kg)		
			U-234	U-235	U-238
1	PT 1759-1	SOIL	397.70 ± 14.53	10.18 ± 0.37	417.07 ± 15.24
2	PT 1760-1	SOIL	312.93 ± 11.43	8.26 ± 0.30	303.41 ± 11.09
3	PT 1761-3	SOIL	254.53 ± 9.30	5.09 ± 0.19	231.23 ± 8.45

MDL – Minimum Detection Limit for counting:- U-234 : 0.2 Bq/kg
U-235 : 0.2 Bq/kg
U-238 : 0.2 Bq/kg

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RADIOACTIVITY ANALYSIS REPORT

Reference No:	**MCRE RESOURCES (180121)(Th,U)**	Date of Issue:	**16 MARCH 2021**
Agency Name:	**MCRE RESOURCES SDN. BHD. (1366182-T)**		
Analysis Technique:	Radiochemical separation followed by direct measurement using Alpha Spectrometry System		

No.	Sample Code	Sample Type/Description	Specific Activity (Bq/kg)		
			U-234	U-235	U-238
1	Felcra 01	SOIL	216.10 ± 7.90	4.68 ± 0.17	221.60 ± 8.10
2	Felcra 02	SOIL	175.76 ± 6.42	3.28 ± 0.12	170.29 ± 6.22
3	PT1759-2	SOIL	351.94 ± 12.86	12.88 ± 0.47	357.56 ± 13.07
4	PT1760-2	SOIL	341.93 ± 12.49	14.20 ± 0.52	340.91 ± 12.46
5	PT1760-3	SOIL	191.06 ± 6.98	5.96 ± 0.22	198.13 ± 7.24
6	PT1762-1	SOIL	78.34 ± 2.86	2.67 ± 0.10	85.95 ± 3.14
7	PT1762-2	SOIL	85.41 ± 3.12	2.93 ± 0.11	97.31 ± 3.56
8	PT1763-1	SOIL	84.96 ± 3.10	2.09 ± 0.08	87.95 ± 3.21
9	PT1763-2	SOIL	124.64 ± 4.55	3.58 ± 0.13	131.08 ± 4.79
10	PT1764-1	SOIL	114.04 ± 4.17	2.83 ± 0.10	115.28 ± 4.21
11	PT1764-2	SOIL	140.57 ± 5.14	5.52 ± 0.20	146.21 ± 5.34

MDL – Minimum Detection Limit for counting:- U-234 : 0.2 Bq/kg
U-235 : 0.2 Bq/kg
U-238 : 0.2 Bq/kg

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Appendix 1-3

OVERVIEW OF THE MALAYSIA MINING HISTORY

BACKGROUND OF MINING IN MALAYSIA

APPENDIX 1-3

1.0 INTRODUCTION

Human community need natural resources for their existence, including minerals, which are essential in the growth and prosperity of the modern way of life. It is necessary to construct roads with aggregates and bituminous materials, to build houses with concrete, or to manufacture cars with aluminum and steel. In the day-to-day, minerals are present everywhere. The communications equipment incorporates numerous minerals, for example, quartz or silica for the silicon chips in PC and in many digital products, including the cell phones. Finally, high-level technological products can incorporate more than 70 different metals. Therefore, exploitation of minerals provides the necessary raw materials for manufacturing, construction, and chemical industries.

In the last decade, the Rare Earth Elements (REE) has attracted globally, tremendous attention from the scientific and industrial communities. In Malaysia, in respond to the increasing demand and potentials for REE, attention has been swift in identifying potential REE resources which further triggered the development of several REE extraction and processing projects. As part of a strategic plan to further strengthen the management of the emerging RE industry, with respect to sustainability in mining and processing, the Government of Malaysia through the Department of Minerals and Geoscience (JMG) and the Ministry of Energy and Natural Resource (KeTSA) have taken a step forward in formulating a comprehensive Standard Operating Procedure (SOP) for the Non-Radioactive Rare Earth Element (NR-REE) mining industry in Malaysia.

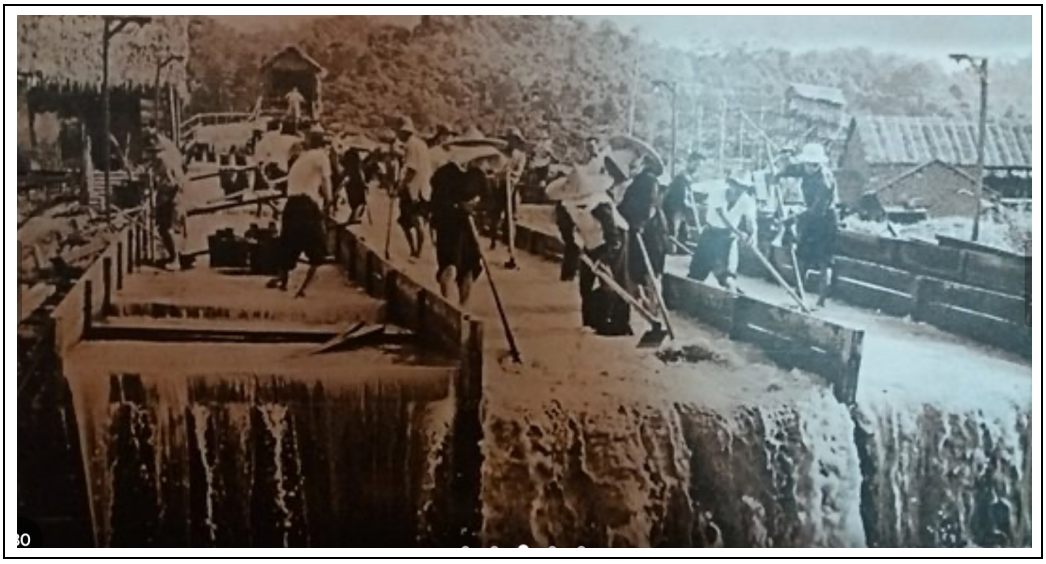
2.0 MALAYSIA MINING HISTORY

Malaysia has been blessed with the presence of at least 34 valuable mineral deposits at various locations in the country. Minerals and in particular tin, a non-renewable natural resource has been the initial driver that propelled early economic development of Malaysia. It accounted for a significant proportion of the nation export earnings before the discovery of petroleum in Peninsular Malaysia in the last 2 centuries. Over the years, with the formulation of New Mineral Policy and revisions of various State Mineral Enactment together with the enactment of Mineral Development Act 1994 have revolutionized the mining industry in Malaysia. The industry players have diversified their outlook beyond

traditional minerals such as tin, gold and iron ore or heavy minerals such as ilmenite, monazite and xenotime from the processing of amang ancient stockpiles.

2.1 World Top Tin Producer

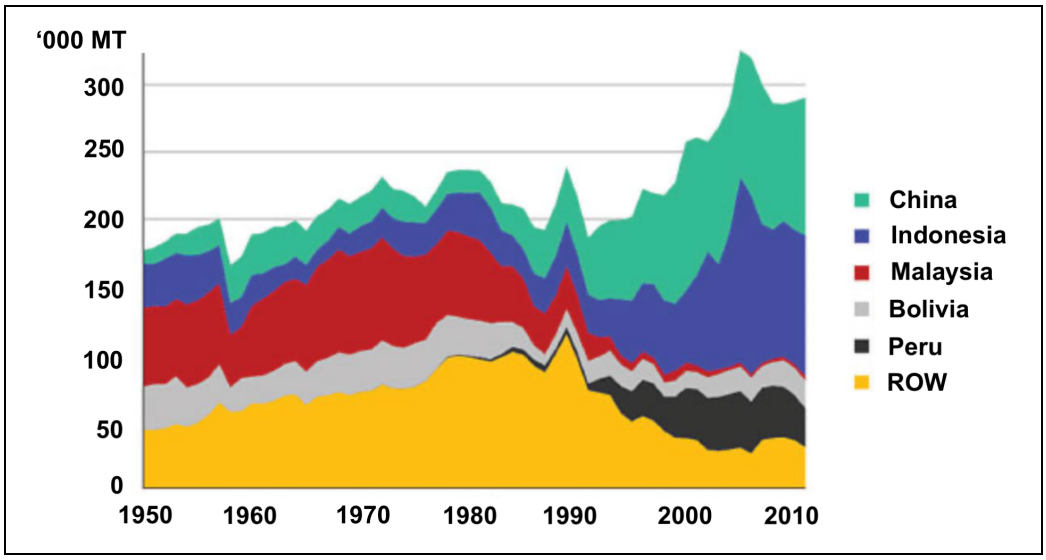
The discovery of large alluvial tin deposits in Perak and Selangor in the 19th century has led to significant foreign investments in the country resulting in positioning Malaysia as a leading world tin producer. Statistics show that Malaysia produced about 50,000 MTs of tin in 1904 which account of about half of the world consumption. With the increasing capital inflows and introduction of mechanized mining methods brought over, mainly by the British has modernized tin mining industry in the country. The large capital injection, managerial expertise, and technology into the industry has further propelled the expansion of mining operations in the country leading to the discovery of more new deposits and opening of new mines. Modern mining method utilizing bucket-wheel dredges with high capacity production has made possible deep-seated tin deposits to be extracted. The traditional gravel pump mines (typically shown in **Plate 2-1**) utilizing hydraulic sluicing has been modernized with the introduction of hydraulic excavators and efficient high capacity pumps. The efficient mining methods coupled with the increasing improvement of rail and road infrastructure has helped lowering the production costs and made possible for the lower grade deposit to be mined. The net result was that more European mines dominated tin production in the country overshadowed the Asian mines in the proportion of 56% to 35% of the world tin production by 1931.



Source: Kinta Tin Mining Museum (2020)

Plate 2-1: First Generation Gravel Pump Mine - Unique Relic of the Past

The world demand of tin has steadily been increasing in the last 3 decades of the 19th century with the increasing use of tinplate cans in the preservation of food. The then Malaya's tin production and its share of world output increased dramatically where it overtook Britain as the world's largest producer. However, growth output in other tin producing countries, particularly in Bolivia, Indonesia, Thailand and China has contributed to the decline in Malaya's share of world output reducing its contribution from 50% to 35% at the turn of the century which further decreased in the last 30 years of the 20th century. Malaysia economic dependent on tin has steadily declined for about 20% of gross export earnings in 1970 and further sliding to less than 10% in 1985 resulting from the collapse of industry, and by the late 1990's contributed less than 1% as shown in **Figure 2-1**. Today tin continued to be mined but not as much as in the past glorious years of the 1970s and 1980s when Malaysia was the world's largest tin ore producer. High grade deposits have inevitably been exhausted following decades of tin mining. With less exploration efforts coupled with competitive land use, no new discovery of economic mineable reserves has been reported.



Source: ITRI (2016)

Figure 2-1: Leading Tin Producing Countries - Long Term Trend

2.2 Post Tin Mining

The demand of minerals continues in line with infrastructure and technological development worldwide. One of the major challenges to the stakeholders, that is the government, industry and society towards effective sustainable development is to secure continuous access to these important economic mineral resources for the needs of the present and future generations (Goh, 2009). The mineral resource industry spin-off has created more employment opportunity and other businesses openings; such as suppliers,

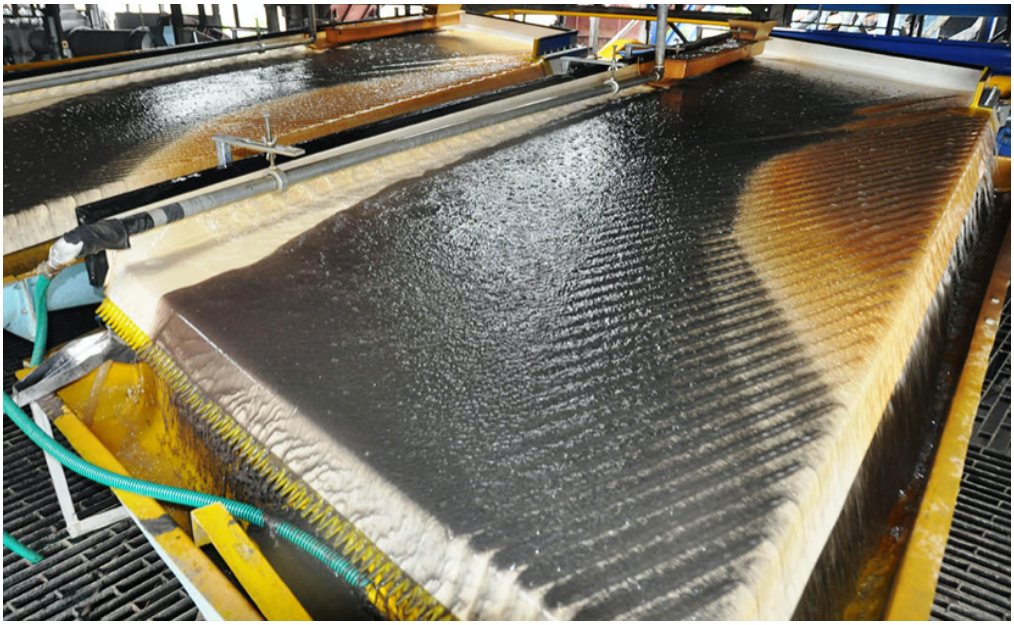
equipment manufacturers, ready-mix industries, consultants, transport sector, analytical laboratories, precast workshops and end-product customers.

Based on statistical records there are 34 types of mineral potentials in Malaysia which includes gold, tin, iron, bauxite, limestone, granite, industrial minerals, clay minerals, coal, heavy minerals and the latest discovery of non-radioactive rare earth elements (REE). It was grossly indicated that these nation's mineral resources have an economic worth of more than US$70 billion (RM280 billion) and should thus be strategically developed for the well-being of the country. The production of the Malaysia's mineral resources and mineral-related industries has contributed about US$1.8 billion (RM7.2 billion) to the nation's Gross Domestic Product with mining and quarrying industry contributed 8.9% to the nation's GDP. Exports of mining and mineral-related goods amounted to US$18 billion (RM75.8 billion) for 2015 while Malaysia's demand for aggregates for infrastructure development has also steadily increased from 75 million MTs in 2008 to 156.5 million MTs in 2015. Overall in 2015, the increase in the demand for minerals by the manufacturing, industrial and construction sectors is very positive and will further improve into the near future.

3.0 MALAYSIA AS REE PRODUCER

Upon the deterioration of world tin market in early 1980s which ultimately led to the collapse of industry in 1985, much efforts have been paid by the industry to diversify their activities and looking for new opportunities. The industry began to reliase the available large stockpiles of amang, particularly in Kinta Valley and Klang Valley are source of new economy. Efforts have been made to beneficiate the available heavy minerals presence from the abundant stockpiles utilizing established processing methods available locally (**Plate 2-2** - Typical example of mineral processing equipment). Monazite and Xenotime have been produced from the scavenging activities. Further downstream processing in collaboration with Japanese investor utilizing the raw material has finally produced the first REE for Malaysia.

Historically, Malaysia has been a producer of REE since in the 1980’s. The Asian Rare Earth (ARE) and the Malaysian Rare Earth Corporation Plant (MAREC) in Perak have been producing REE products derived from monazite and xenotime, the heavy minerals from amang, by-products of the tin industry. The plants however have been closed in 1992 resulting from a long court process which finally disposed not in favour of the 2 REE producers. The main issue of the court litigation was concerning the storage and management of the radioactive waste generated by the operations.



Source: Kilang Amang Onn Sdn. Bhd. (2020)

Plate 2-2: Shaking Tables - Commonly used Processing Equipment in Amang Plant

In the recent years, Lynas Malaysia Sdn. Bhd. with its plant Kuantan holds a unique position as the world's second largest REE producer and the only significant producer outside China. The plant processes imported Rare Earth concentrate from Mount Weld mine in Australia. The Lynas Advance Material Plant (LAMP) was designed and built in 2 phases, with full Phase 2 capacity capable of producing up to 22,000 TPA of separated Rare Earth Oxide (REO) products. Lynas has been recognized as a leading supplier of sustainable Rare Earth materials with the supply chain traceable from mine to finished magnets, through their operations and qualified partners. This security of supply is essential for sustainable market growth. Lynas produced high quality products which include Neodymium and Praseodymium (NdPr) used in magnets, Lanthanum (La), Cerium (Ce), and Mixed Heavy Rare Earths (SEG).

Lynas Malaysia Sdn. Bhd. operation is similar to that of the Asian Rare Earth (ARE) and Malaysian Rare Earth Corporation (MAREC), utilizing imported monazite, REE bearing minerals to produce REE products. In the process they produced radioactive contaminated wastes which have been a subject of concerned by various parties.

Table 1 reflects the overall scenario of REE import and export of Malaysia. In 2019, Malaysia imports monazite concentrates from Australia worth RM304.319 million and export the REE products to various countries amounting to RM1,034.354 million which are tremendous value increment of the processed products.

Table 1: Malaysia Import and Export of Rare Earth (2016 – 2019)

Mineral	H.S. Code	2016		2017		2018		2019	
		Tonne	RM ('000)	Tonne	RM ('000)	Tonne	RM ('000)	Tonne	RM ('000)
Import									
Xenotime	2530.90.100	25	45						
Thorium Ores (Monazite)	2612.20.100	-	-	-	-	-	-	-	-
Thorium Ores (Monazite)	2612.20.0000	-	-	-	-	-	-	-	-
Rare Earth Metals	2805.30.0000	22,130	290,482	28,853	324,932	29,867	303,400	26,225	304,319
Cerium Compounds and other than Cerium Compounds	28.46	176	7,510	529	38,086	289	21,996	213	28,926
Export									
Xenotime	2530.90.100	20	97	-	-	-	-	-	-
Thorium Ores (Monazite)	2612.20.100	222	1,856	48.25	422	-	-	-	-
Thorium Ores (Monazite)	2612.20.0000	-	-	326.40	326	50.76	668	76.29	976
Rare Earth Metals	2805.30.0000	-	-	-	-	-	-	-	-
Cerium Compounds and Other than Cerium Compounds	28.46	15,973	662,280	23,832	1,097,397	23,152	1,079,994	21,382	1,034,354

Source: Jabatan Mineral dan Geosains (2020)

Appendix 3-1

GENERAL OVERVIEW OF THE GEOLOGICAL AND STRUCTURAL CHARACTERISTICS OF REE DEPOSIT

GENERAL OVERVIEW OF THE GEOLOGICAL AND STRUCTURAL CHARACTERISTICS OF REE DEPOSIT

APPENDIX 3-1

1.0 INTRODUCTION

The geological and structural characteristics of the proposed mining area need to be determined and described. The distribution area of acidic intrusive rocks if any and the exposed rock strata shall be fully defined. Typically, in Malaysia in the process of continuous weathering erosion cycle, the weathering speed is greater than the denudation, forming a relatively gentle hilly topography, which is advantageous to the chemical weathering, and making the surface acidic intrusive rocks of the upper develop into a large-scale weathering crust.

2.0 GEOLOGICAL AND STRUCTURAL CHARACTERISTICS OF REE DEPOSIT

The rocks which are normally rich in REE are decomposed under weathering, and the REE ions therein migrate and are adsorbed, eventually enriched in the middle and lower part of the weathering crust to form Rare Earth deposits. Therefore, the ore-bearing horizon of the weathering crust ion-adsorbed REE deposits in this area is the weathering crust of acidic intrusive rocks.

REE ore bodies are located in the middle and lower part of the weathering crust. It is difficult to determine the boundary between the upper and lower layers of ore body in the field, which depends on the test results to divide the boundary. The reason why the ore bodies are distributed in the middle and lower part of the weathering crust is that the REE ions at the top of the weathering crust migrate to the middle and lower parts of the weathering crust to be adsorbed and enriched by clay minerals along with the infiltration and leaching of surface water. On the profile, the ore bodies are often concentrated in the middle and lower part of the weathering crust. The grade change form looks like parabola, with the highest grade in the middle, and the grade up and down shows a downward trend or even pinches out.

The vertical stratification of ore-bearing weathering crust vertically upward (from bottom to top) which consists of semi-weathered layer and whole weathering layer. Typical semi-weathered layer main components are quartz, feldspar sand and gravel 30% ~ 50%,

mica, kaolin and other clay minerals 50% ~ 70%, clay minerals from top to bottom become less, sand and gravel from top to bottom become more. It contains a small amount of spherical weathered residual spheres, and the content of Rare Earth oxides in ionic phase is generally less than 0.065%, with a thickness of 2 m ~ 5 m thick.

The whole weathering layer is the In-Situ residual completely weathered bedrock, with brown yellow mixed with gray white and purplish red. The upper part is clay structure and the lower part is sandy clay structure. Main minerals at the upper part is dominated by clay minerals (about 85%), containing a small amount of silty quartz and feldspar (about 15%); the lower part is dominated by clay minerals (about 70%), containing more fine feldspar and quartz sand grains (about 30%). Ion-adsorbed Rare Earth elements are adsorbed by clay minerals in a cationic state and are often concentrated in the middle and lower part of the layer. This layer is generally 2 m ~ 8 m thick and has a gradual transition relationship with the upper cover without obvious boundary. The total weathering layer is the main occurrence site of the deposit, and the content of Rare Earth oxides in ionic phase is generally 0.060% ~ 0.110%. **Figure 1** illustrates typical schematic of REE Ion-Adsorption clay deposition in Malaysia.

3.0 EXPLORATION METHODS AND EQUIPMENT

The thickness of weathering profile in Malaysia is regionally variable from a few meters to up to 15 m. Shallow shaft, similar as that of Bangka Drill, commonly used in alluvial tin exploration is the main exploration method for prospecting mineral resources in weathering crust. Drilling depth of the shallow shaft is generally less than 20 m. The depth of the mechanized version of the drill can reach 30 m, but it is a time-consuming, laborious method with security problems. Typical equipment and machinery used in the ion-adsorption REE exploration are as depicted in **Figure 2**. Gannan Drill (**Figure 3**), also called Probing Shovel, is a chosen method which could not only drill with large thicknesses but also be efficient, 3 –10 times than Shallow Shaft or Shallow Drill, cost-effective with the unit price is about 25% of Shallow Shaft and about 15% of Shallow Drill and much safer. At present, sampling by Gannan Drill instead of shallow shaft is being widely applied in the exploration of regolith-hosted deposits.

Plate 1 and **Plate 2** show progressing onsite manual preparation of liquid injection holes for the In-Situ Leaching mining operation of ion-adsorption clay deposit in Guangxi Rare Earth, China.

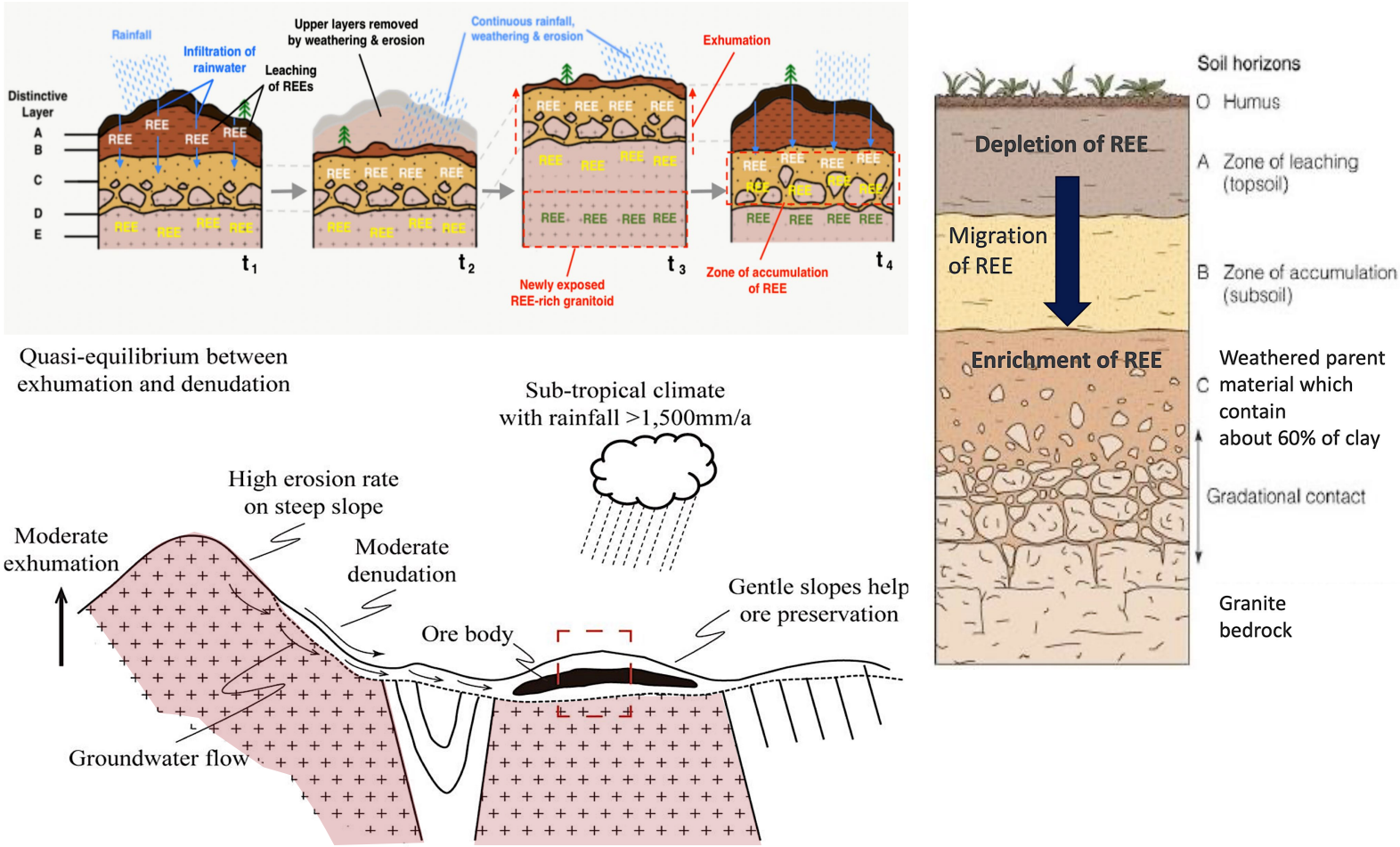


Figure 1: Typical Schematic of REE Ion-Adsorption Clay Deposition in Malaysia

Source: Deng et al (2018)

Figure 2: Simple Drilling Equipment and Machinery for the Ion Adsorption REE Exploration

Source: SBA (2021)

Figure 3: Gannan Drill, Simple Drilling Equipment for the Ion Adsorption REE Exploration

Source: Chinalco (2019)

Plate 1: On-site Manual Preparation of Liquid Injection Holes for the In-Situ Leaching Mining Operation of Ion-Adsorption Clay Deposit in Guangxi Rare Earth, China

Source: Chinalco (2019)

Plate 2: Preparation of Pregnant Solution Diversion Holes for the In-Situ Leaching Mining Operation of Ion-Adsorption Clay Deposit in Guangxi Rare Earth, China

Appendix 3-2

RELATIONSHIP BETWEEN EXPLORATION RESULTS, MINERAL RESOURCES AND MINERAL RESERVES

RELATIONSHIP BETWEEN EXPLORATION RESULTS, MINERAL RESOURCES AND MINERAL RESERVES

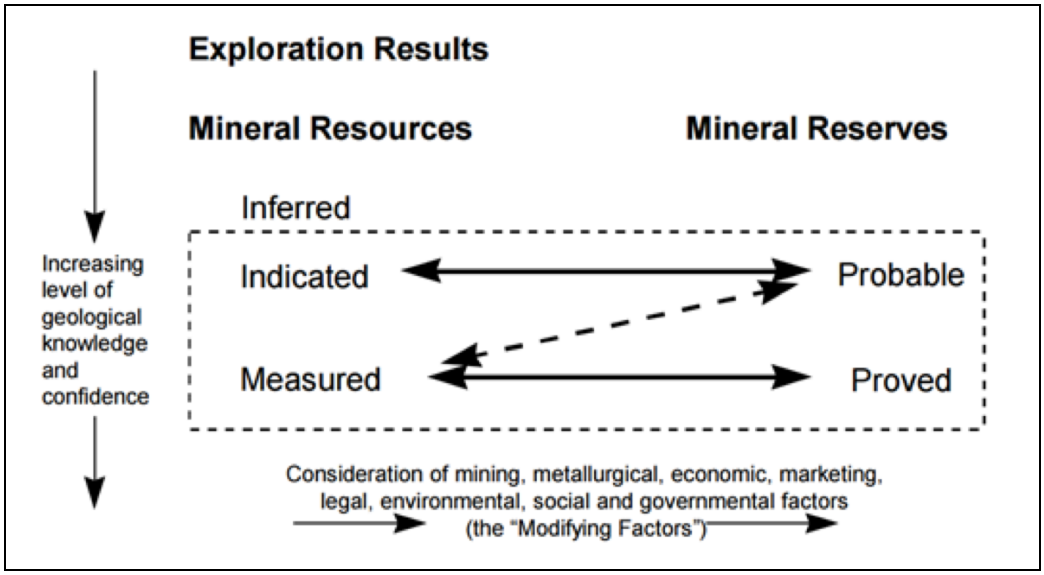
APPENDIX 3-2

1.0 INTRODUCTION

Reserve evaluation is made from the results of the mineral explorations. The confidence level of the evaluation will increase depending of the number of samples taken and the sampling pattern (such as random sampling or consistent gridded pattern). This will directly affect the feasibility study to be made in applying for mining lease.

2.0 MINERAL RESOURCES

A Mineral Resource is a concentration or occurrence of material of intrinsic economic interest in or on the earth's crust in such form, quality and quantity that there are reasonable prospects for eventual economic extraction. Mineral Resources are further sub-divided, in order of increasing geological confidence, into inferred, indicated and measured as categories as depicted in **Figure 1**.



Source: CRIRSCO (2013)

Figure 1: General Relationship Between Exploration Results, Mineral Resources and Mineral Reserves

2.1 Inferred Mineral Resource

Inferred Mineral Resource is the part of a mineral resource for which quantity, grade (or quality) and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified geological or grade continuity. It is based on information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes which may be of limited or uncertain quality and it is also reliability.

2.2 Indicated Mineral Resources

Indicated resources are simply economic mineral occurrences that have been sampled (from locations such as outcrops, trenches, pits and drill holes) to a point where an estimate has been made, at a reasonable level of confidence, of their contained metal, grade, tonnage, shape, densities, physical characteristics.

2.3 Measured Mineral Resources

Measured Resources are indicated resources that have undergone enough further sampling that a 'competent person' (defined by the norms of the relevant mining code; usually a geologist has declared them to be an acceptable estimate, at a high degree of confidence, of the grade (or quality), quantity, shape, densities, physical characteristics of the mineral occurrence.

3.0 MINERAL RESOURCES

There are differences between mineral reserve and mineral resource. Definition of the relevant terms used in reporting mineral reserves are as shown in **Table 1**.

Table 1: Definition of Terms Related to Mineral Reserve

No.	Terms	Definition
1.	Mineral Reserves (or ore reserves)	Resources known to be economically feasible for extraction
2.	Reserves	Either Probable Reserves or Proved Reserves
3.	Probable Ore Reserve	✧ Part of indicated, and in some circumstances, measured mineral resources that can be mined in an economically viable fashion. ✧ It includes diluting material and allowances for losses which may occur when the material is mined.

No.	Terms	Definition
		✧ Has a lower level of confidence than a Proved Ore Reserve but is of sufficient quality to serve as the basis for decision on the development of deposit
4.	Proved Ore Reserve	✧ Part of Measured Resources that can be mined in an economically viable fashion. ✧ It includes diluting materials and allowances for losses which occur when the material is mined. ✧ Represents the highest confidence category of reserve estimate. ✧ The style of mineralization or other factors could mean that Proved Ore Reserves are not achievable in some deposits.
5.	Drilling Grid Spacing (Maximum)	✧ Measured Resources – 50 m x 50 m ✧ Indicated Resources – 200 m x 200 m ✧ Inferred Resources – 500 m x 500 m
5.	Description of Mineral Reserve	✧ The regolith of the Ion-Adsorption type REE ore bodies shall be delineated. ✧ The length and width of the exploration area together with the control of the ore bodies, such as by stratum, structure, magmatic rocks and weathering crust should be described. ✧ The Ion-Adsorbed REE ores reserve should be calculated – Average wet weight of raw ore at normal temperature, average humidity, average dry weight of raw ore to be defined. ✧ Delineation of the REE ore body within the project site should be clearly shown in plan. ✧ Components of the REE reserve as analyzed from the drilling samples should also be reported.
5.	Density	✧ To obtain sufficient number of density measurements, important in deposits affected by significant weathering ✧ Deposits with supergene enrichment of the RE have considerably lower densities than the primary mineralization, typically 1.6 – 1.9 MT/m^3 as compared of 2.9 MT m^{-3} for the underlying relatively un-mineralised carbonatite.
6.	Cut-off Grade	✧ Choice of cut-off grade must support the premise that there are reasonable prospects for eventual economic extraction of the Mineral Resource. ✧ Total costs of development must be considered and a realistic value attributed to all components of the mining, concentration, separation, purification and market

No.	Terms	Definition
		presentation stages of the individual REE products planned for marketing.

Appendix 5-1

TECHNICAL BACKGROUND OF THE IN-SITU LEACHING ION-ADSORPTION CLAY MINING

TECHNICAL BACKGROUND OF THE IN-SITU LEACHING ION-ADSORPTION CLAY MINING

APPENDIX 5-1

1.0 INTRODUCTION

Ion-Adsorption Clay formed by the weathering crust of granite. REE are absorbed in secondary clay minerals in ionic state. Clay minerals in the weathering crust are the enrichment sites and important carriers of REE. In-Situ Leaching of ionic REE uses leaching solution to exchange and leach the adsorbed REE ions from heterogeneous ore bodies under natural conditions.

Typically, in practice the proposed mining area is divided into a number of sub-area which are based on the geological setting and topographical features of the area as normally elaborated in the OMS Plan of the operation. The arrangement of In-Situ Leaching ore blocks is generally based on the condition of ore body occurrence and the physical geometry arrangement.

2.0 LEACHING MECHANISM

According to the metallogenic theory of ionic REE deposit, ionic REE deposit is formed by weathering and eluviation of the primary ore of magmatic granite containing REE under appropriate conditions. In the process of mineralization, about 90% of the REE minerals in this type of ores are adsorbed on the surface of clay minerals such as kaolinite and muscovite in a cationic state. These REE cations with exchange status can be exchanged by cations with greater exchange potential energy. The equation is as follows:

$$\text{(Clay Mineral) m. } RE^{+3} + 3nA^{+} \text{ (Clay Mineral) m3n } A^{+} + n\ RE^{+3}$$

When ammonium sulfate is used as mother liquid, the exchange mechanism is as follows:

$$2\ (\text{Kaolin})^{-3}\ RE^{+3} + 3(NH_4)^{+1}{}_2SO^{-2}{}_4 \rightarrow 2\ (\text{Kaolin})^{-3}6(NH_4)^{+1} + RE_2{}^{+3}(SO_4)^{-2}{}_3$$

In In-Situ Leaching, the ore leaching solution is continuously injected into the ore body through a liquid injection hole under a certain head pressure, and the cation with higher exchange potential in the solution will exchange with the REE ions in the adsorbed state,

so that the REE ions enter the leaching solution. The process of this multidirectional solid-liquid exchange system is as follows:

Infiltration diffusion → exchange → rediffusion → reinfiltration, and the diffusion force is the concentration difference. The solution (or underscreen water) continuously injected into the ore body extrudes the REE leaching solution that has been exchanged. The process flowchart of the In-Situ Leaching of the REE deposit is as shown in **Figure 1** and detailed in **Figure 2**. Photographs showing various activities commencing from the In-Situ Leaching to the precipitation process are depicted in **Plate 1** to **Plate 11**.

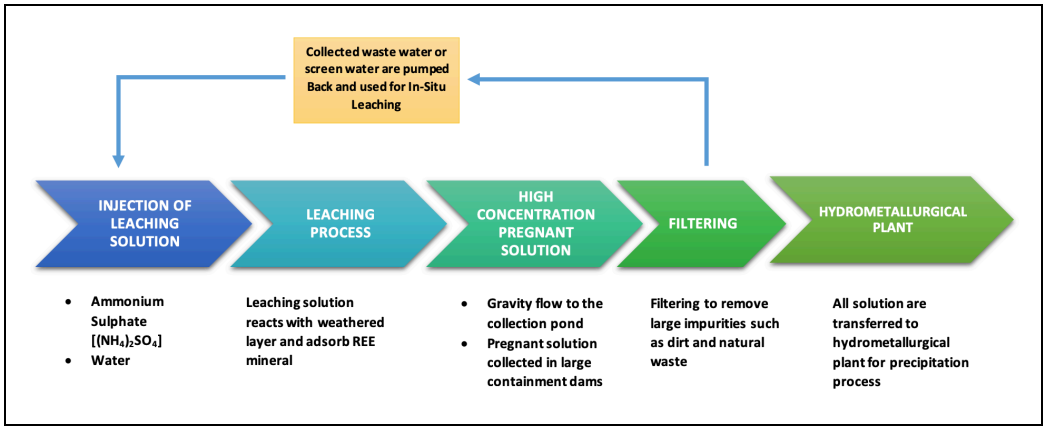


Figure 1: The Process Flowchart of the In-Situ Leaching of The REE Deposit

Plate 1: Piping Network System for the In-Situ Leaching Mining Operation of Ion-Adsorption Clay Deposit in Guangxi Rare Earth, China

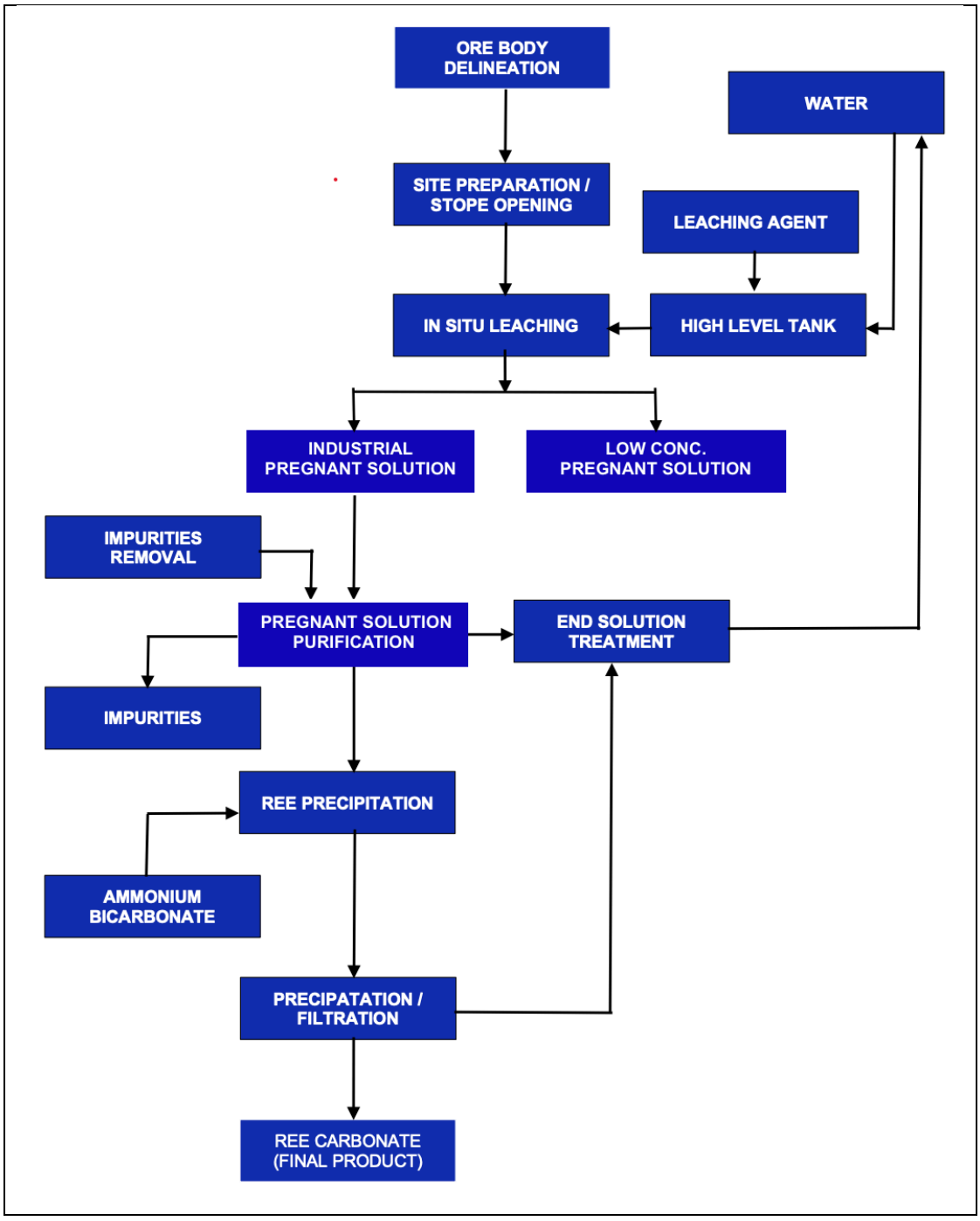
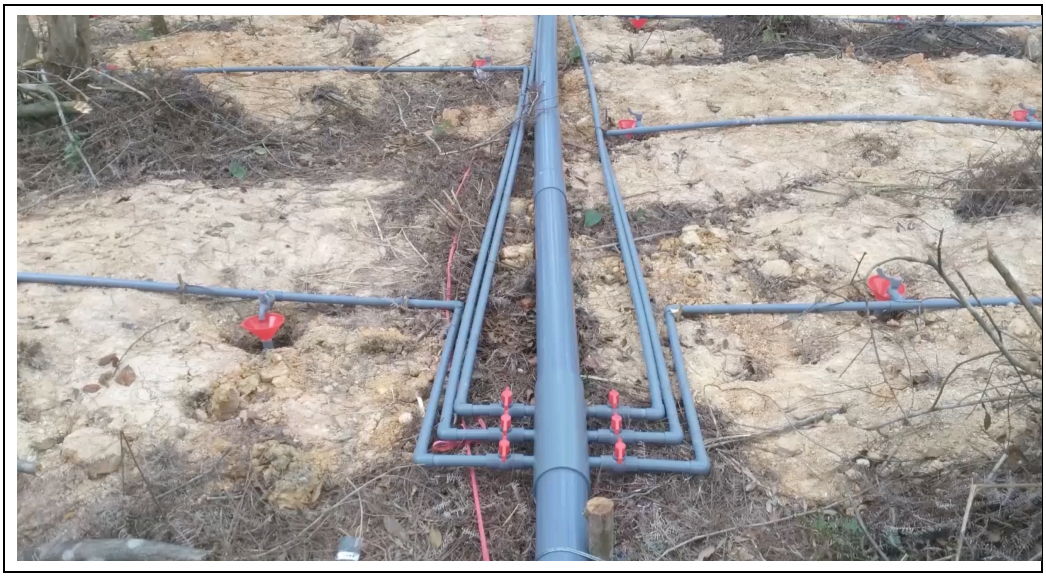


Figure 2: In-situ Leaching of REE Ion-Adsorption Deposit Process Flowchart

Plate 2: Dripping of Leaching Solution to the Ion-Adsorption RE Clay Deposit through the Injection Hole at the In-Situ Leaching Mining Operation in Guangxi Rare Earth, China

Plate 3: Leaching Solution Reticulation Network System for the In-Situ Leaching Mining Operation of Ion-Adsorption Clay Deposit in Guangxi Rare Earth, China



Source: Chinalco (2019)

Plate 4: Another View of Leaching Solution Reticulation Network System for the In-Situ Leaching Mining Operation of Ion-Adsorption Clay Deposit in Guangxi Rare Earth, China

Plate 5: Storage of Leaching Solution Located at High Elevation Tank as Part of the Reticulation Network System for the In-Situ Leaching Mining Operation of Ion-Adsorption Clay Deposit in Guangxi Rare Earth, China

3.0 THE IN-SITU LEACHING OPERATION

The liquid injection method from top to bottom is adopted, and the liquid injection volume at each different place is controlled according to the thickness of the ore body. The concentration adjustment sequence is based on the principle of first concentration and

then dilution. The initial preparation is made at the concentration of 2.0 % and 1.0 %, which is depending on the specific production situation. Ammonium sulfate solution is injected into the In-Situ Leaching area through the injection hole, so that the leaching solution can be exchanged with the raw ore in the In-Situ Leaching area. The leaching pregnant solution is collected through the liquid collection system to the hydrometallurgical plant for subsequent treatment.

Plate 6: Diversion Holes of Pregnant Solution and the Collection Ditch for the In-Situ Leaching Mining Operation of Ion-Adsorption Clay Deposit in Guangxi Rare Earth, China

Plate 7: Another View of Diversion Holes of Pregnant Solution and the Collection Ditch as Part of the Reticulation Network System for the In-Situ Leaching Mining Operation of Ion-Adsorption Clay Deposit in Guangxi Rare Earth, China

Plate 8: Processing Pools as Part of RE Carbonate Processing Facility at an In-Situ Leaching Mining Operation of Ion-Adsorption Clay Deposit in Guangxi Rare Earth, China

Plate 9: Processing Pools as Part of RE Carbonate Processing Facility at an In-Situ Leaching Mining Operation of Ion-Adsorption Clay Deposit in Guangxi Rare Earth, China

Under the condition of non-damaging the surface vegetation and surface excavation, the leaching solution is directly injected into the ore body through the liquid injection hole where a comprehensive piping system shall be installed as shown in **Figure 3**. Cross-section profile which illustrates the injection holes setting into the REE deposit is attached in **Figure 4** and **Figure 5.** A liquid collection system is constructed at the bottom of the ore body to recover the leached REE pregnant solution, which is pumped to a hydrometallurgical plant for processing. The end product of the process is RE Carbonate. The ISL mining production operation is relatively safe. It can mine ore that cannot be mined by conventional mining methods. The economical and reasonable mining of lean

and off-balance ore can greatly improve the utilization rate of mineral resources and effectively reduce production costs. This mining method changes the traditional mining method and does not require facilities such as mining, crushing, transporting and tailings treatment. Does not destroy vegetation and natural landscape, and has less impact on the ecological environment.

Plate 10: Filter Press for Water Separation of the Precipitated RE Carbonate

4.0 REE PROCESSING

Process flowchart of the REE refining is as shown in **Figure 6**. The pregnant solution from the In-Situ Leaching area is collected and then pumped to the transferring tank of pregnant solution in the hydrometallurgical plant. The pregnant solution flows into the impurity removal tank, and the mixture is continuously stirred evenly by an air pump. The pH value of the pregnant solution in the tank is controlled to be about 5.4, and the pregnant solution after impurity removal is clarified and then is put into a sedimentation tank for sedimentation.

In the impurity removal process, impurities are separated out by using different pH values required for carbonate precipitation and hydroxide precipitation generated by impurity ions and REE, and the purpose of separation is achieved through solid-liquid separation. Impurities precipitated from the impurity removal tank are called slag heads, and the main ingredients for containing Al, Mg, Fe and other elements of the precipitation. Due to the high REE content in the slag head, the slag head is transferred to the slag head pool, concentrated sulfuric acid is used to dissolve the slag head, diluted with clear water after dissolution is completed, and then the supernatant is transferred to the impurity removal pool for REE recovery. The precipitate after acid dissolution of the slag head is called tail

slag, which is sold to professional manufacturers in bags. The cleaning process takes about 12 hours. The equations are as follows:

$$Al^{3+} + 3OH^- \rightarrow Al(OH)_3\downarrow$$
$$Fe^{3+} + 3OH^- \rightarrow Fe(OH)_3\downarrow$$
$$Ca^{2+} + CO_3^{2-} = CaCO_3\downarrow$$
$$Mg^{2+} + CO_3^{2-} = MgCO_3\downarrow$$

Plate 11: RE Carbonate, the Mine Final Product Packed in Jumbo Bags

4.1 Pregnant Solution Precipitation

The pregnant solution after removing impurity flows into the sedimentation tank and adding saturated ammonium bicarbonate aqueous solution into the pool, continuously stirring uniformly with an air pump, and controlling the dosage of the ammonium bicarbonate aqueous solution until the pH value of the pregnant solution in the pool is about 6.7. After the solution in the tank is clarified, the precipitated part is RE Carbonate, and the upper solution is supernatant. The supernatant can be put into the liquid preparation tank for treatment and then mixed again or used as underscreen water. The precipitation process takes about 8 hour ~ 10 hour. The equation is as follows:

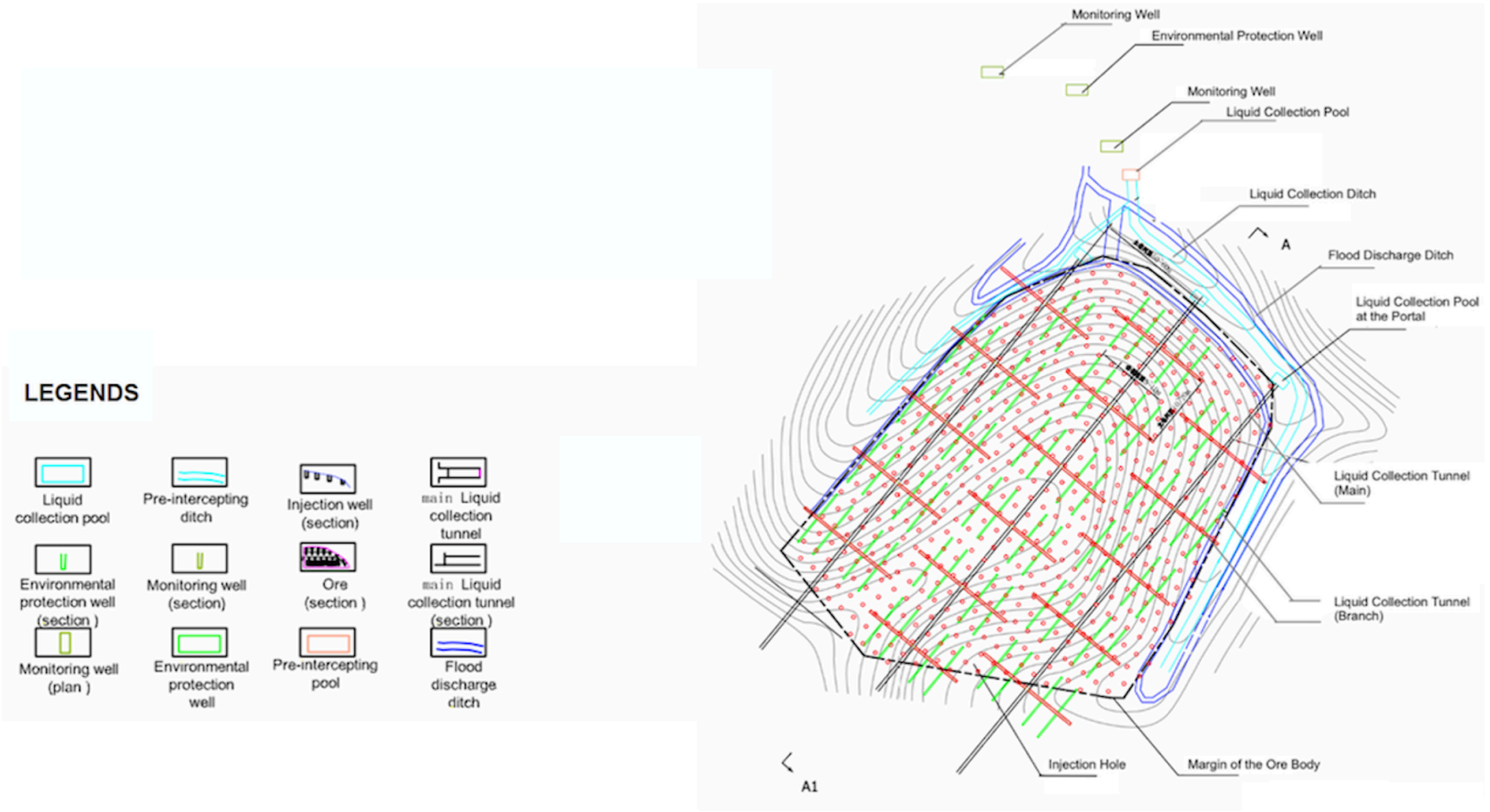


Figure 3: Typical Schematic of REE Ion-Adsorption Clay Deposition in Malaysia

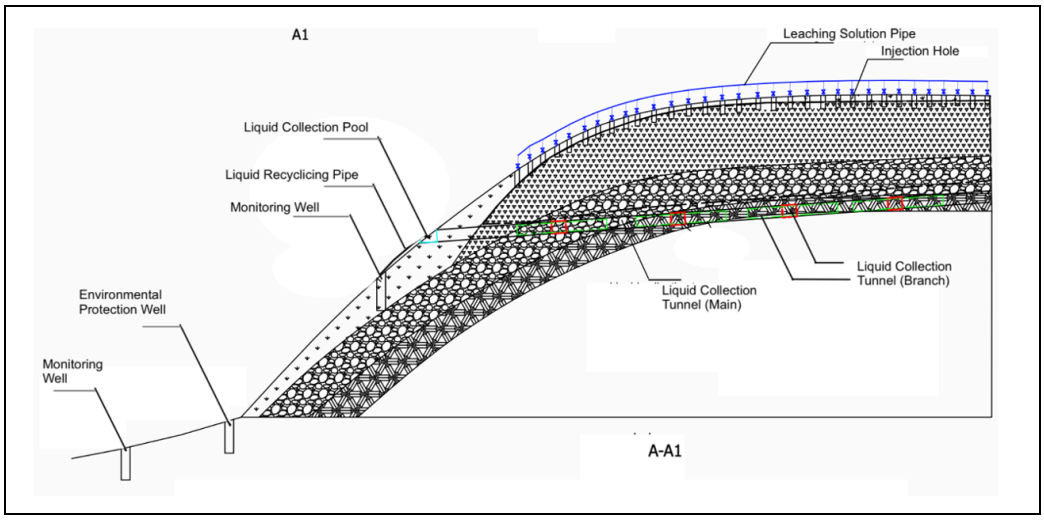
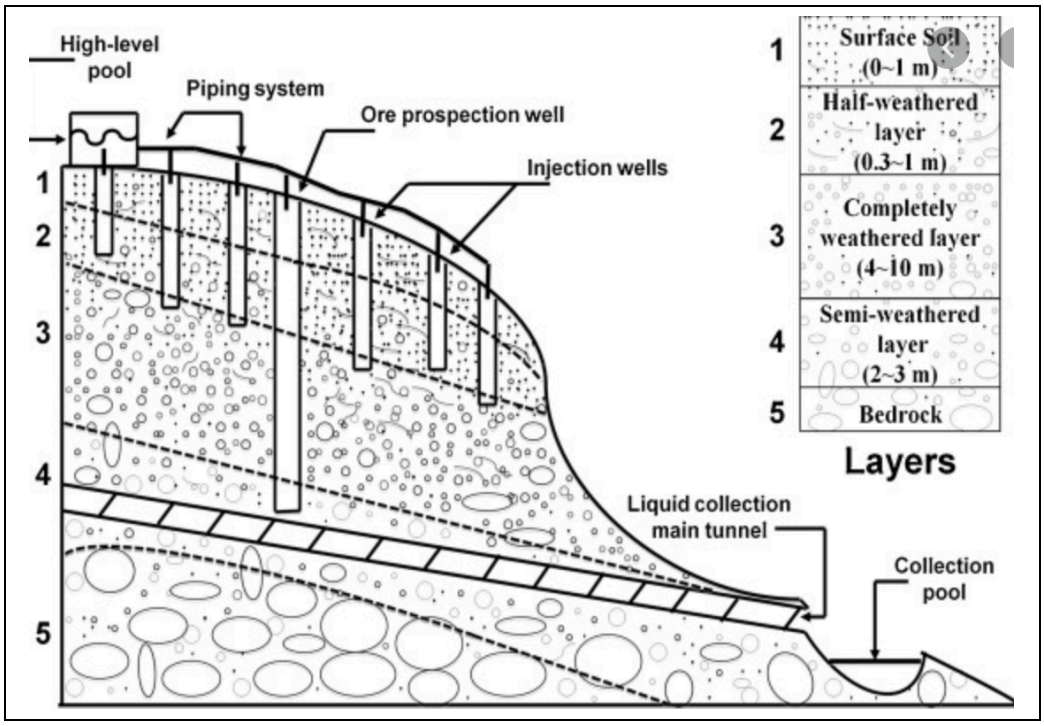


Figure 4: Typical Cross-Sectional Profile of the Injection Holes Setting into the REE Deposit



Source: Vahidi et al (2016)

Figure 5: Typical Layers of Mining Site for Ion-Adsorption Clays

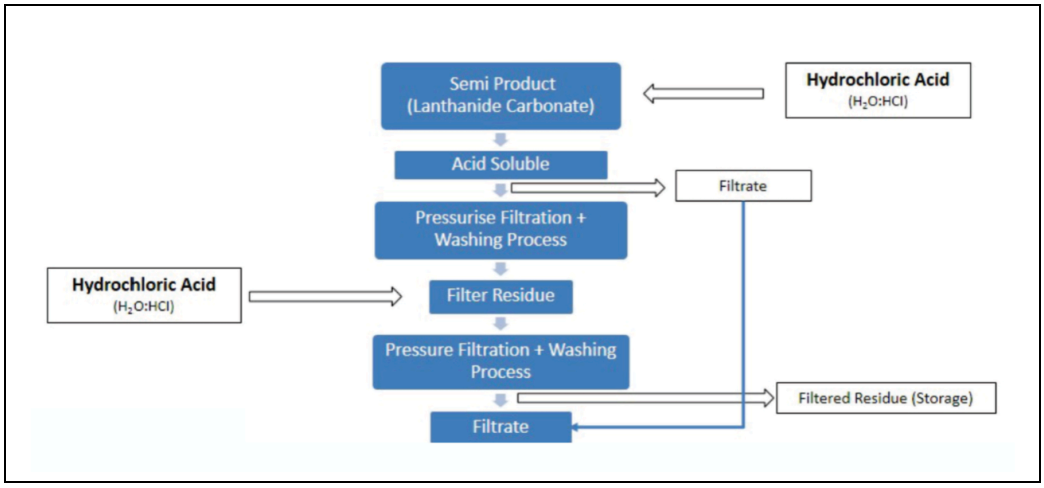


Figure 6: Flowchart of the REE Refining Process

$$2RE^{3+} + 6HCO_3 \rightarrow RE_2(CO_3)_3 \downarrow + 3CO_2 \uparrow + 3H_2O$$

4.2 Aging Crystallization of RE Carbonate

The precipitated part of the sedimentation tank is RE Carbonate, which is put into the sedimentation tank and aged for about 10 hour to form RE Carbonate crystals. The product is packaged and put into storage after being pressed by the filter press. The pressed filtrate is put into the clarifying tank for clarification, and the supernatant is returned to the liquid preparation tank to prepare ore pregnant solution. The pressed filtrate residue is the product. The products can be sold after being packed and put into storage.

5.0 PROCESS CONTROL

Process control is the active changing of the process based on the results of process monitoring. Once the process monitoring tools have detected an out-of-control situation, the person responsible for the process makes a change to bring the process back into control. During the production phase, the main pollution production links are the engineering construction process of the injection hole in the In-Situ Leaching area, the collecting tunnel, as well as the pregnant solution treatment process in the mineral processing plant.

Followings are some of the pertinent process control in the operation of the project:

- ✧ The HDPE film is used for seepage prevention in the tank wall of the mineral processing plant. Leakage of the tank wall can be controlled by strengthening inspection and monitoring the groundwater around the mineral processing plant, and timely repairing the leakage point of the HDPE film in the tank wall. Leakage from the pool wall will affect the local soil around the pool body of mineral processing plant locally and temporarily.
- ✧ Ammonium bicarbonate is unstable in chemical properties and easy to decompose and volatilize during storage and use, thus generating ammonia gas. Volatilization is related to air humidity, temperature and other factors, and ammonium ion is involved in the production reaction. Proper control shall be implemented to effectively managed the storage and use of the chemical.
- ✧ Wastewater Produced in the Mineral Processing Plant – Under normal circumstances, the pressure filter wastewater and the supernatant of the sedimentation tank generated in the pregnant solution treatment process are all recycled and utilized, and the wastewater is not discharged.
- ✧ Long - term monitoring of the water quality of the drainage ditch outside the In-Situ Leaching zone shall be carried out. Once it is found that pH, ammonia nitrogen, etc. exceed the specified limits, the immediate back-pumping measures shall be taken, and the drainage ditch shall be withdrawn to the mineral processing plant for recycling without discharging.
- ✧ Tailings from the mineral processing plant – The tailings generated in the cleaning process of the treatment of pregnant solution depend on the production capacity, which is temporarily stored in the tailings tank and will be sold off.
- ✧ Exhaust gas pollution sources – The pollution sources of the atmospheric environment during the production period are mainly the unorganized emission dust and the volatile ammonia gas produced in the production of ammonium bicarbonate, which are produced during the construction of liquid injection hole and liquid collecting system in the In-Situ Leaching zone.
- ✧ Leakage of pregnant solution during water injection in In-Situ Leaching area – Close monitoring on the process particularly on the liquid injection, liquid collection, decontamination diversion and pipelines need to be carried out.

Appendix 5-2

TECHNICAL BACKGROUND OF EROSION AND SEDIMENT CONTROL

BACKGROUND ELEMENTS OF EROSION AND SEDIMENT CONTROL

APPENDIX 5-2

1.0 INTRODUCTION

The main activities during the mine development and operation stage which may have direct impacts pertaining to erosion and sediment is the infrastructure development activity involving land clearing, filling and leveling within the project area, particularly on the hydrometallurgical plant site. Section 10(1), Mineral Development Act 1994 stipulates that an OMS must be submitted and approved before a mining operation may commence its operation. Aspects of erosion and sediment control are issues of concerned which shall be taken into consideration in the preparation of OMS. Nevertheless, under the current practice, 2 other documents which need to be prepared with respect to erosion and sediment control are ESCP and LDP2M which are under the purview respectively by JPS and JAS. Without prejudice to the jurisdictions of JPS and JAS on the subject at hand, it is most appropriate that the requirements for erosion and sediment control be incorporated under the requirement of OMS.

2.0 EROSION AND SEDIMENT CONTROL PLAN

Preparation and submission of Erosion and Sediment Control Plan (ESCP) to the Department of Drainage and Irrigation (JPS) for approval is currently one of the COA of an EIA for a mining project. An ESCP is a document that identifies the methods and devices implemented to minimise erosion and sediment loss from the proposed project site as a result of soil disturbing activities. The proposed In-Situ Leaching mining method shall not involve site clearing, nevertheless, the hydrometallurgical plant and the mine infrastructure area, though small shall require some minimum earthworks to be carried out.

2.1 Impacts of Erosion and Sedimentation

The main activities during the RE mine development stage which may have direct impacts pertaining to erosion and sediment is the infrastructure development activity which may involve filling and leveling within the project area, particularly on the hydrometallurgical plant site. Potential impacts from these activities are:

- ✧ Soil erosion, and associated sediment pollution and siltation, particularly during the initial land clearing and overburden stripping activities.
- ✧ Loss of topsoil; loss of topsoil may be due to soil erosion and mixing with the overburden materials during the stripping and stockpiling activities.
- ✧ Loss of fauna, flora, and their habitats.
- ✧ Hydrological changes; increased runoff due to the clearing of existing vegetation, and changes to groundwater regime.

2.2 Land Disturbing

The impacts of earthwork activities on water are quite imminent in view of its nature of operation, which may cause direct physical disturbance. Any disturbance either physical or chemical on the watercourse will have direct consequences on the water usage. The effects of on surface water vary depending on the depth of the excavation area with respect to water table, nature of the strata of the ground and working method. The potential effects of a earthwork activities on surface water regime are summarised as follows:

- ✧ It alters the surface over which water flows.
- ✧ It changes the pattern and quantity of surface water flows through the clearing and pitting activities, and where required, the diversion of on-site and off-site watercourses.
- ✧ It changes the physical and chemical quality of water, particularly with runoff from the stockpiles and working faces, and effluents discharged from settlement ponds and other treatment facilities.
- ✧ The surface watercourse may be silted up due to erosion of un-grassed soil and overburden mound and the working faces.

Exposed bare soil is easily eroded by rainfall and so surface runoff from project areas is frequently rich in sediment. These eroded soils often contain adsorbed metals and other trace elements. In addition, when some of the associated minerals are exposed, chemical reactions leading to acidification may occur. The chemistry of the surface water, which comes into contact with these materials, will similarly be affected.

2.3 Land Clearing and Earthworks

Land clearing and earthworks are the main activity, which may cause soil loss. The main concern would be during the construction of haulage road and preparation of the designed platform. However, if the site were abandoned halfway through the site preparation stage, the cleared area would soon be colonised and covered by the pioneer vegetation. If the project is progressing as planned, there will be no soil or loose materials to erode along the hill slope as the area shall be retained as green-belting. The preparation of excavation benches could trap any run-off from the upper riser slope by

the next lower bench. Nevertheless, potential soil erosion is a concern, and can be damaging the environment if it is not handled properly. However, the relatively flat land shall only impose impact of siltation rather than erosion.

Soil erosion and sedimentation as a result of land clearing and earthworks can cause both environmental and economic impacts. Environmental impacts may build up slowly and not produce dramatic result for many years when it will be too late to rectify the problem.

2.4 Soil Erosion

When land clearing activities are being undertaken, the potential for soil erosion by hydrological forces and subsequent sediment pollution will be greatly increased. These hazards will be most when the vegetative cover has been removed and the exposed soils are further disturbed. For alluvial flats and very gentle slopes of less than 6^0, surface erosion will be minimal because of the relatively flat terrain.

It is expected that earthwork activities will increase both the volume and intensity of rainfall run-off from construction areas as a result of reduced water infiltration, interception and uptake. The project area experiences moderately heavy rainfall particularly during the wet season. The rainfall provides significant potential for soil/ exposed subsoil erosion which can result in sedimentation/ siltation of off-site areas.

2.5 Soil Erosion Modelling

Some form of soil erosion modelling may predict the anticipated amount of soil erosion. There are a few predictive models that could be used, but the most widely used and perhaps the most reliable method is based on the so-called **Universal Soil Loss Equation (USLE)**. All values of parameters in this equation were obtained from the MSMA (2nd Edition) and the ESC Guidelines for the relevant site conditions. Universal Soil Loss Equation (USLE) can be used to assess the erosion risk of a mine site under 3 conditions, that are existing (undisturbed), disturbed without mitigation measures (no ESC), and disturbed but controlled (with ESC).

2.6 Predicted Soil Erosion Risk

Using procedure as prescribed in the MSMA (2nd Edition) and the ESC Guidelines, the soil loss for a mine site can be determined. It can be observed that uncontrolled land disturbance can cause significant increase in erosion risk. Annual soil loss at various zones increase due to the increase in elevation factors where cut and fill has cause dramatic increment in elevation difference compared to existing condition. However, the

ESCP provides corrective measures to mitigate the situation by providing terracing practice. In certain area the soil loss are significantly reduced even in uncontrolled condition compared to exiting condition because of the flatten land for development. Eventually, the implementation of ESCP manages to minimise increment of soil loss to a satisfactory level.

2.7 Sedimentation

Soil erosion and sedimentation can cause both environmental and economic impacts. Environmental impacts may build up slowly and not produce dramatic result for many years when it will be too late to rectify the problem.

The design of all sediment control BMPs requires the information on the quantity of sediment it is expected to trap. Therefore, determination of sediment yield for sediment basin catchment area is required for this site.

The sediment yield within the project area should be determined for possible highest sediment yield condition, i.e. during the earthwork and overburden stripping (pre-bulk grading plan). The Modified Universal Soil Loss Equation (MUSLE) is used to determine the sediment yield for sediment basin.

The Modified Universal Soil-Loss Equation (MUSLE) calculates the sediment yield in a watershed to a specific location for a specific storm event. This allows for volume determinations for sediment traps or basin based on design storms rather than area volume ratios.

3.0 EMP DOCUMENTATION

The preparation, submission of EMP is based on JAS Environmental Impact Assessment Guidelines in Malaysia (2016). An EMP is a document containing the organizational structure, responsibilities, procedures, and resources to deal with all relevant environmental issues and to achieve effective and long-term compliance in environmental protection. It intends to outline the actions to be taken to manage the impacts from the project activities. The EMP Guidelines prescribed that the EMP shall at a minimum contain 5 chapters, covering the following subjects:

- ✧ Approved project layout plan
- ✧ Project implementation schedule
- ✧ Name of EMP Preparer
- ✧ Corporate policy statement of environmental management and protection

- ✧ Commitment by the top management on the mainstreaming of environmental agenda
- ✧ Instilling of self-regulation in the development project
- ✧ Ensuring continuous compliance with the environmental regulatory requirements.
- ✧ Organization chart of the Project Proponent top management with responsibilities on environmental management and protection
- ✧ Contact details of Environmental Manager, Environmental Officer (EO), Engineering
- ✧ Consultant, Contractor, Site Supervisor and Competent Person
- ✧ Name of the relevant Environmental Consultant and Accredited Laboratory
- ✧ Plan for staff training in order to develop competency to discharge responsibilities on environmental requirements and compliance
- ✧ EIA Approval Conditions (COAs)
- ✧ LDP2M2 document
- ✧ Pollution prevention and mitigation measures (P2M2) to be implemented

4.0 LAND DISTURBING - POLLUTION PREVENTION MITIGATION (LDP2M2)

One of the major components of an EMP is the preparation of Land Disturbing - Pollution Prevention Mitigation (LDP2M2) document. The document is to be attached or inserted into the EMP as part of the EMP submission requirement. LDP2M2 document is a legal fledge document made by the Project Proponent to take efforts, measures, actions, or due diligence in accomplishing the overarching goal of protecting the environment and in mitigating the environmental impact in the process of implementation of the proposed development project.

4.1 Guidance Note

LDP2M2 is to be prepared based on the Guidance Document, Document on Land-Disturbing Pollution Prevention and Mitigation Measures (LDP2M2) (JAS 2016). The LDP2M2 gives guidance to the Project Proponent's personnel especially the Environmental Officer (EO), in supervising the implementation of the LDP2M2 that includes the installation, inspection and maintenance of the Best Management Practices (BMPs) as well as in preparing the required documentation and the relevant reports. The focus of the LDP2M2 is on the prevention, mitigation and control of the discharge from the development area containing the major pollutant (suspended solids) resulting from land disturbing activities.

The LDP2M2 document also contain schedule of construction activities detailing the project phasing, construction stages and sequences that progress with the implementation of each of the LDP2M2s in a timely manner.

4.2 LDP2M2 Plan and Construction Notes

A plan consisting of maps and/or site plans showing the existing geomorphology and land use of the site, to be overlaid with site development map that depict the proposed land disturbing activities or earthworks, inclusive of proposed area alterations and the locations of all P2M2s facilities. Construction notes which refer to general instructions of P2M2s application, shall be included in the LDP2M2 plan or may written on a separate sheet. Method Statement and layout plan to be implemented for the major land disturbing activities of the project that may cause the discharge of pollutants, particularly suspended solids shall also be part of the document.

Appendix 5-3

GUIDELINES ON THE PREPARATION
OF OMS BY JMG

JABATAN MINERAL DAN GEOSAINS MALAYSIA
DEPARTMENT OF MINERAL AND GEOSCIENCE MALAYSIA

INTERIM GUIDELINE ON PREPARATION OF AN OPERATIONAL MINING SCHEME

JMG.G.P.XX

KEMENTERIAN AIR, TANAH DAN SUMBER ASLI MALAYSIA
MINISTRY OF WATER, LAND AND NATURAL RESOURCES

JABATAN MINERAL DAN GEOSAINS MALAYSIA

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CONTENTS

APPENDICES

1.0 INTRODUCTION

1.1 One of the functions of the Minerals and Geoscience Department (JMG) is to ensure that mining operation is conducted in a safe and efficient manner and with proper attention given to the protection of the environment.

1.2 Before the commencement and development of any new mining project or major development of an existing operation, the holder of a proprietary mining lease (PML) or mining lease (ML) must obtain a written approval to proceed from Director of Mines.

1.3 For mining project that falls within the category of Schedule Activities as defined under the Environmental Quality (Prescribed Activities) (Environment Impact Assessment) Order 2015, the project proponent is required to conduct an Environmental Impact Assessment (EIA) study for the approval of the Department of Environment (DOE). Thus in preparing the operational mining scheme, the consultant, as defined by sub regulation 3(3) of the Mineral Development (Operational Mining Scheme, Plans and Record Book) Regulations 2007, should take into account the conditions imposed by the DOE pertaining to the EIA approval. The scheme should include all mitigating measures to minimize environmental impacts, if any, arising from the mining operation.

2.0 LEGAL REQUIREMENT

Section 10 of the Mineral Development Act 1994 requires the holder of a proprietary mining licence or mining lease to submit for approval by the Director of Mines an operational mining scheme for development work and mining on the land which is the subject of such mineral tenement before the commencement of any development work or any mining within the mineral tenement area.

Section 12 of the Act also requires that the holder of a proprietary mining licence or mining lease to comply with the approved mining scheme under section 10 and carry out development work and mining in accordance with such approved operational mining scheme.

The contents of the operational mining scheme submitted for approval should also be in line with the Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulation 2007.

3. APPLICATION FOR OPERATIONAL MINING SCHEME (OMS)

3.1 The Director requires that a written account of the mining proposal be submitted during an application for his approval of an OMS (written as "mining scheme" after this). Checklist of the documents needed for applying for a mining scheme approval is as in **Appendix A**. The scheme is required to address matters pertaining to the safety and environmental management of the proposed mining project from its commencement until the end of the operational life.

2.1 A proponent should submit 4 copies of the textual report of the mining scheme to the Director of MGD of the state in which the project is to be carried out and the number of plans and sections as specified in **Appendix B**

2.2 Presentation of the proposed mining scheme by the consultant maybe required by the Director depending on the sensitivity of the mining project to the local environment.

2.3 The tenement holder also needs to submit through his consultant a half yearly compliance report after the mining scheme has been approved.

4.0. CONTENTS OF MINING SCHEME REPORT

4.1 SUMMARY

A summary of the mining scheme proposal covering major aspects of the operation including mineral processing should be given. Details of locations and tenement should be described.

List of commitments by the holder to safeguard the safety of personnel and properties as well as the well being of the surrounding environment also need to be included.

4.2 INTRODUCTION

Objectives

A brief summary of the scale and type of operation planned and an outline of critical project dates for development works and commencement and completion of mining operation.

The proposed rehabilitation programme of the tenement would also need to be outlined.

Location of mine

Brief description of the location of the mine relative to the nearest township or public and private interests including any nearby operating mine. A locality map should also be provided.

Ownership

Details of ownership of the proprietary mining license or mining lease covered by the proposed mining scheme, including name of holder(s) and status of any deeds and agreement. The name and address of main operators and contractors.

History

Description of previous exploration, other mining and land development activities in the area.

4.3 EXISTING ENVIRONMENT

Existing facilities

Description of existing facilities, land use / conflicting interest, if any. Planned use of any existing facilities, including the use of public roads.

Geology

Brief description of geology specific to the area of interest,

- Formation, bedrock, type of rocks / soils,
- type of ores/deposits
- ground stability
- structural geology

Ore reserves

Basic description of mineralization and ore reserves divided into measured, probable or inferred reserves accompanied with exploration results. Areas planned for immediate mining.

Hydrology

Brief summary of surface or subsurface water flow regime and quality. Details of water requirement including the source, quantity and quality.

Flora and fauna

Brief description of the flora and fauna in the area including also geological heritage, if any.

Environmental and structural Geology

Description of the relationship of geological conditions to potential environmental and safety hazard

4.4 PROJECT DESCRIPTION

Mining

a. Location of the proposed mine workings.

b. Outline of proposed method of operation, pit design and waste dump design.

c. Schedule for all surface and underground development work

d. Both long term conceptual plan as well as detailed plans for the first few years of operation

e. An assessment of ground stability of the workings of the mine and waste dump.

f. Mining equipment to be used.

g. For underground operation, details on the information for method of working, underground development work including the engineering drawings, ventilation system, roof support, pumping requirement, lighting, blasting and distribution of services connected thereto.

h. Methods and procedures for removal of mineral ores.

i. Haulage and traffic management.

j. Safety procedures for development work and mining operation.

k.

Ore processing

a. A description of the treatment plant and general arrangement plan should be supplied.

b. Processing and smelting method, if any, including equipment and hazardous materials to be used.

c. Details of heap leaching process, if employed.

d. Methods for handling hazardous materials and explosives, including transportation, usage and storage.

Wastes and tailings disposal

a. Storage of tailings, top soils, overburden, mineral ores and wastes.

b. Methods and procedures for removal of waste rock and tailings.

c. Characteristics of waste and tailings materials should be specified.

d. Specific waste dump management of waste rocks (backfilling of pits, erosion or leachates control) is required.

e. Outline of proposed tailings disposal arrangement plan should be provided.

f. Management of tailings process lines and piezometers installed should be specified.

g. An assessment of ground stability of the workings of waste dump and tailings dam

Support facilities

Details of location of site office, workshops, power supply, accommodation units, etc. should be supplied.

Workforce

State category and number of workers required during each phase of development works and production. Status of competency and training requirement under the laws should be acknowledged. Work permit for foreigners.

Transportation

Access to mine lease area must be specified and authorization by the local authority should be submitted together with the scheme.

4.5 ACCOMMODATION AND HOUSING

The housing and accommodation arrangements for the workforce should be described where applicable.

4.6 ENVIRONMENTAL PROTECTION MEASURES

In this section the proponent should briefly provides the forms of impacts from his operation and his commitments to minimise disturbances and manage adverse impacts.

Environmental protection measures including pollution control (air, water, noise, vibration and visual), monitoring and contingency plan should be mentioned.

The information provided should be in line with his commitment to the EIA conditions of approval under the EQA Regulations where applicable.

Other information needed:

- Baseline data for air, water and noise quality
- Proposed plan and measures to prevent or minimise erosion
- Proposed erosion and sediment control structure locations (including discharge location into surface water)
- Acid Mine Drainage (AM) or Acid Rock Drainage (ARD),
- Heavy metals, cyanide, arsenic, and other pollutants.
- Quarterly Monitoring and reporting requirement

4.7 REHABILITATION AND MINE CLOSURE

Commitments to undertake progressive and final rehabilitation and site clean up. The details should be in line with the Rehabilitation Plan provided by the proponent to the State Government under the State Mineral Enactment.

4.8 PLANS

The scheme report should be appended with plans, cross-sections and other relevant illustrations. Refer to **Appendix B.**

4.9 CERTIFICATION

The scheme has to be prepared, signed and certified by a Professional Mining or Quarrying Consultant registered under the Engineers Act in accordnce to the best mining engineering practice.

APPENDIX A

Check list for the preparation of an Operational Mining Scheme:

New application:

- Form A/A1(if applicable) ☐
- Form D (if applicable) ☐
- Form 49 (if applicable) ☐
- Copy of Mining Lease OR Proprietary Mining Licence ☐
- Operational Mining Scheme Report ☐
- Appointment letter or Power of Attorney (if applicable) ☐
- Form B1- B4 (if applicable) ☐
- Form 24 (if applicable)
- Memorandum & Article of Association (if applicable) ☐
- EIA approval (if applicable) ☐
- Consultant appointment letter ☐
- Agreement or letter of deeds for mining contractor (if applicable) ☐
- Rehabiliation Plan (if applicable) ☐

Renewal application

- Operational Mining Scheme Report ☐
- Appointment letter or Power of Attorney (if applicable) ☐
- Consultant appointment letter ☐
- Agreement or letter of deeds for mining contractor (if applicable) ☐

Application for Amendment

- Operational Mining Scheme Report ☐
- Development approval (if applicable) ☐
- Appointment letter or Power of Attorney (if applicable) ☐
- Consultant appointment letter ☐
- Rehabilitation Plan (if applicable) ☐
- Agreement or letter of deeds for mining contractor (if applicable) ☐

APPENDIX B

PLANS AND SECTIONS REQUIRED FOR APPROVAL OF AN OPERATIONAL MINING SCHEME

The following plans and sections (where applicable) are to be limited together with the written account of a proposed mining scheme;

I. General Plan

General surface layout to include the followings;

a. Land boundary
b. Surface facilities and adjacent public interest
c. Operation site
d. Processing plant, stockpiles etc
e. Waste disposal areas, tailings pond and settling ponds
f. Topography and local drainage system
g. Water supply, intake points, discharge points

Specific to underground mine-

h. drawing on the horizontal plane for each level showing all underground workings, including shafts, electrical and ventilation systems, tunnels, diamond drill holes and bulkheads

II. Cross-section of;

a. Proposed mine faces from bottom of the mine pit to it's top edge

b. Overburden waste rock disposal areas including proposed measured for stability and environmental control

c. Tailings pond and settling pond-including proposed measures for stability and environmental control

Specific to underground mine-

d. Drawing on the vertical plane of all mine sections at suitable intervals and azimuths, showing all shafts, electrical and ventilation systems, tunnel, drifts, stopes and other mine workings in relation to the surface, including the location of any known watercourse or body of water

Plans

i. All plans must be provided with legends and status of land title and coloured accordingly to highlight certain features the number of copies of plans and sections to be submitted;

a. surface Layout –(7) copies

b. Other plans and sections – (7) copies

ii. A plan should as far as possible be prepared on a suitable scale together with an inset key plan on a scale of 1 : 50000 in accordance to R.S.O Grids

iii. At the bottom right hand corner of the plan, a box of an appropriate size shall be provided and the following information shall be inserted there in;

a. Name of mine, locality, mukim, district and state

b. Litho and topo sheet numbers

c. Purpose of plan

d. Scale

e. Reference Boundary Stone (to be indicated by letter 'fd' on plan) from which the survey was carried out

f. Date of survey; Drawn by; Approved by

g. Certification and signature of Consultant

Appendix 5-4

CIRCULAR OF JMG DIRECTOR GENERAL – CIRCULAR NO. 1/2018 DATED 5 MAR 2018 AND CIRCULAR NO. 1/2020 DATED 1 JULY 2020

PEKELILING KETUA PENGARAH GALIAN MALAYSIA
BILANGAN 1/2018

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PENAMAAN DAN FORMAT SURAT KELULUSAN SKIM PENGENDALIAN MELOMBONG (SKSPM) SERTA PROSEDUR KELULUSAN SKIM PENGENDALIAN MELOMBONG BAGI TUJUAN PERMOHONAN MELAKSANAKAN KERJA PEMBANGUNAN DAN PERLOMBONGAN

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1. TUJUAN

Pekeliling ini bertujuan untuk memaklumkan kepada Pengarah Galian (PG) dan Penolong Pengarah Galian (PPG) mengenai kaedah penamaan dan format serta prosedur kelulusan bagi Surat Kelulusan Skim Pengendalian Melombong (SKSPM) ke atas permohonan melaksanakan kerja pembangunan dan perlombongan di negeri masing-masing yang telah dipersetujui di dalam Mesyuarat Ketua Unit Lombong dan Kuari (KULK) bilangan 1/2018 pada 26 Februari 2018.

2. LATAR BELAKANG

2.1 Mesyuarat Ketua Unit Lombong dan Kuari (KULK) bilangan 1/2018 pada 26 Februari 2018 telah bersetuju untuk melaksanakan penambahbaikan bagi kaedah pengeluaran SKSPM yang diluluskan oleh Pengarah Galian (PG) menurut peruntukan di bawah Seksyen 10, Akta Pembangunan Mineral 1994 (APM 1994) bagi tujuan penyelarasan dan sebagai langkah proaktif jabatan untuk meningkatkan tadbir urus dan integriti dalam pembangunan perlombongan dan pemprosesan sumber mineral negara.

2.2 Pada masa ini, semua kelulusan bagi skim pengendalian melombong hanya dibuat oleh PG dan proses penyediaan laporan dan pemeriksaan tapak lombong diselaraskan oleh PPG bersama kakitangan Unit Lombong dan Kuari yang lain.

2.3 Berdasarkan pemerhatian, didapati berlaku ketidakseragaman di dalam penamaan surat kelulusan di mana terdapat negeri yang menamakan surat kelulusan sebagai *"Surat Kebenaran Skim Pengendalian Melombong"* manakala di negeri lain pula menamakan sebagai *"Surat Kelulusan Skim Pengendalian Melombong"*. Perbezaan ini boleh menyebabkan berlaku kekeliruan kepada industri perlombongan dan pemprosesan mineral.

3.0 PENAMAAN DAN FORMAT SKSPM

3.1 Nama bagi surat kelulusan ini telah diputuskan sebagai:

a) **Surat Kelulusan Skim Pengendalian Melombong (SKSPM)** atau

b) **Approval Letter of Operational Mining Scheme (ALOMS)**

3.2 Nama tersebut hendaklah digunakan bagi merujuk kepada sebarang urusan berkaitan APM 1994.

3.3 Format Surat Kelulusan Skim Pengendalian Melombong (SKSPM) adalah sepertimana di **Lampiran A**. Syarat-syarat kelulusan adalah tertakluk kepada kesesuaian teknikal di lombong dan mengambil kira amalan terbaik di dalam bidang perlombongan.

4.0 PROSEDUR KELULUSAN SKIM PENGENDALIAN MELOMBONG

4.1 Satu Jawatankuasa Penilaian Teknikal Skim Pengendalian Melombong hendaklah dibentuk bagi tujuan menilai kebolehlaksanaan skim pengendalian melombong yang dikemukan oleh pemegang tenement mineral samada bagi permohonan baharu atau pembaharuan.

4.2 Keahlian Jawatankuasa Penilaian Teknikal adalah berbeza mengikut kategori lombong iaitu Lombong Sensitif dan Lombong Tidak Sensitif.

4.3 Takrifan bagi lombong sensitif adalah seperti berikut:-

a) Yang melebihi mana-mana had pengeluaran berikut:

(i) dalam hal pengambilan mineral dari deposit aluvium primer, pengeluaran tahunan 3.5 juta meter padu setahun;

(ii) dalam hal operasi perlombongan bawah tanah, pengeluaran bijih lombong gabungan tahunan, pengeluaran sisa dan overburden sebanyak 100,000 tan setahun (bahan buangan yang tidak keluar dari mulut lombong adalah dikecualikan); atau

(iii) dalam hal operasi perlombongan dedah yang mengekstrak galian daripada deposit primer bukan logam, pengeluaran bijih lombong gabungan tahunan, sisa dan penghasilan tambahan sebanyak 300,000 tan setahun;

c) Dengan modal dan pelaburan infrastruktur melebihi seratus lima puluh juta ringgit;
d) Dengan lebih daripada 250 pekerja atau pekerja di tapak lombong pada hari biasa (termasuk semua syif); atau
e) Yang menggunakan mana-mana amalan perlombongan yang berikut:
   (i) penggunaan meletup yang meluas dan berterusan;
   (ii) litar pengapungan berterusan; atau
   (iii) penggunaan bahan kimia atau agen toksik yang meluas dan berterusan.

f) Jarak kawasan kerja atau loji pemprosesan yang terlalu berhampiran (kurang dari 500 meter) dari penempatan penduduk dan harta benda awam,

4.4 Takrifan bagi lombong tidak sensitif adalah selain dari para 4.3.

4.5 Ahli Jawatankuasa Penilaian Teknikal:

a) Lombong Sensitif

(i)	Pengarah JMG,	- Pengerusi
(ii)	Pengarah Galian/ Timbalan Pengarah Lombong dan Kuari	- Setiausaha
(iii)	Pengarah/Wakil Pejabat Tanah dan Galian/ Jabatan Tanah dan Survei/Jabatan Tanah dan Ukur,	- Ahli
(iv)	Pengarah/Wakil Jabatan Alam Sekitar/ Lembaga Sumber Asli & Alam Sekitar/ Jabatan Perlindungan Alam Sekitar, dan	- Ahli
(v)	Pengarah/Wakil dari Jabatan teknikal yang lain jika perlu	
(vi)	Unit Lombong dan Kuari	- Urusetia

b) Lombong Tidak Sensitif

(i)	Pengarah JMG,	- Pengerusi
(ii)	Pengarah Galian/ Timbalan Pengarah Lombong dan Kuari	- Setiausaha
(iii)	Timbalan Pengarah Sumber Mineral	- Ahli
(iv)	Unit Lombong dan Kuari	- Urusetia

4.6 Fungsi Jawatankuasa Penilaian Teknikal

a) Selepas Pengarah Galian (Setiausaha) menerima laporan cadangan skim pengendalian melombong, hendaklah dengan seberapa segera menetapkan tarikh bagi Jawatankuasa Penilaian Teknikal mengadakan pemeriksaan tapak dan mesyuarat.

b) Pemegang Tenemen/wakil dan Jurutera Perunding Perlombongan/ Sumber Mineral (Prinsipal Konsultan) adalah diwajibkan hadir semasa sesi pemeriksaan tapak.

c) Pengerusi hendaklah memperuntukkan satu slot khas kepada Pemegang Tenemen/wakil dan Jurutera Perunding Perlombongan/Sumber Mineral (Prinsipal Konsultan) bagi tujuan pembentangan cadangan skim pengendalian melombong kepada jawatankuasa sebelum mesyuarat dimulakan.

d) Pengarah Galian dalam tempoh dua (2) minggu selepas Mesyuarat hendaklah memaklumkan secara bertulis kepada Pemegang Tenemen setiap keputusan samada lulus, tolak atau penambahan maklumat terhadap permohonan SKSPM dan hendaklah disalinkan kepada Ketua Pengarah Galian, Jurutera Perunding Melombong/Sumber Mineral dan Jabatan teknikal yang terlibat.

e) Jawatankuasa juga hendaklah menetapkan tempoh kelulusan SKSPM antara minima 2 tahun hingga maksima 5 tahun berdasarkan kepada kesesuaian teknikal dan cadangan lain di dalam laporan skim pengendalian melombong.

5. **TARIKH KUAT KUASA DAN PEMAKAIAN**

5.1. Pekeliling ini hendaklah dipatuhi oleh semua Pengarah Galian dan berkuatkuasa serta merta.

5.2. Semua perkara di dalam Pekeliling ini hendaklah merujuk dan tertakluk kepada peruntukan-peruntukan di dalam Akta Pembangunan Mineral 1994.

5.3. Pejabat JMG negeri adalah dipertanggungjawabkan untuk melaksanakan pekeliling ini.

(DATUK SAHAR EFFENDI BIN ABDULLAH AZIZI)
Ketua Pengarah Galian
Jabatan Mineral dan Geosains Malaysia

Bertarikh:

PEKELILING KETUA PENGARAH GALIAN
JABATAN MINERAL DAN GEOSAINS MALAYSIA
BILANGAN 1/2020

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PROSEDUR PERTIMBANGAN PERMOHONAN SURAT KELULUSAN SKIM PENGENDALIAN MELOMBONG (SKSPM) DI KAWASAN SENSITIF

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1. TUJUAN

Pekeliling ini bertujuan menjelaskan mengenai proses baharu permohonan Surat Kelulusan Skim Pengendalian Melombong (SKSPM) di JMG Malaysia sebagai langkah untuk memperbaiki tadbir urus (governance) di bawah Akta Pembangunan Mineral 1994 seperti yang dipersetujui oleh Pengurusan Tertinggi JMG. Pekeliling ini memperkenalkan beberapa langkah penambahbaikan seperti permohonan SKSPM bagi kawasan sensitif yang kini akan dibawa ke Ibu Pejabat untuk pertimbangan oleh Ketua Pengarah.

2. TAFSIRAN

"pegawai yang dilantik" ertinya mana-mana pegawai yang telah dilantik di bawah Akta Pembangunan Mineral 1994;

"kawasan sensitif" ertinya Pajakan Melombong atau Lesen Melombong Tuan Punya yang:

a) jumlah keluasan (aggregate area) kurang dari 50 ekar (20 hektar);
b) terletak di bahagian hulu sungai (upstream) muka sauk kepada Loji Rawatan Air (LRA);
c) baharu diluluskan dan dikenakan EIA tetapi bukan untuk pengeluaran agregat pembinaan;
d) diluluskan tanpa melalui proses permohonan carigali atau penjelajahan; dan
e) diluluskan untuk mineral strategik

"Ketua Pengarah" ertinya Ketua Pengarah Galian yang dilantik di bawah seksyen 4 Akta Pembangunan Mineral 1994 dan termasuklah mana-mana Timbalan Ketua Pengarah Galian dan mempunyai semua kawalan,

arahan dan pengawasan ke atas Pegawai Yang Dilantik di bawah sub-seksyen 4 (2) Akta yang sama;

"mineral strategik" ertinya mineral tertentu yang dianggap penting kepada pertumbuhan ekonomi negara seperti nadir bumi bukan radioaktif;

"Surat Kelulusan Skim Pengendalian Melombong" ertinya kelulusan Pengarah ke atas suatu skim pengendalian melombong bagi kerja pembangunan dan perlombongan di atas tanah pajakan melombong atau lesen melombong tuan punya sebelum apa-apa kerja pembangunan atau perlombongan boleh dimulakan;

"Pengarah" ertinya seorang Pengarah Galian yang dilantik di bawah seksyen 4 dan termasuklah mana mana Timbalan Pengarah Galian;

"Jawatankuasa SKSPM Ibu Pejabat" ertinya suatu jawatankuasa yang dipengerusikan oleh Ketua Pengarah dan ahlinya terdiri daripada beberapa Agensi teknikal yang ditentukan oleh Ketua Pengarah;

3. LATAR BELAKANG

3.1 Pada 28 Mei 2020, Yang Berhormat Menteri Tenaga dan Sumber Asli telah mengeluarkan kenyataan bahawa "Kerajaan dalam memastikan industri mineral memberi sumbangan besar kepada ekonomi negara akan menggalakkan lebih banyak aktiviti eksplorasi sumber mineral dijalankan terutamanya kajian dan pembangunan ke atas mineral strategik seperti elemen nadir bumi (REE)".

3.2 Di samping itu, Malaysia telah komited untuk melaksanakan Sustainable Development Goals (SDGs) yang telah dipersetujui oleh komuniti antarabangsa di mana pada tahun 2030 sumber asli termasuk mineral hendaklah diuruskan secara mampan dan digunakan secara efisien.

3.3 Untuk merealisasikan hasrat Kerajaan terhadap komitmen SDGs dan menjana kekayaan baharu, KeTSA melalui JMG akan melaksanakan dasar-dasar mengenai industri mineral seperti:

i. Kawalan ke atas sumber mineral strategik/ kritikal
ii. Pengusaha kompeten daripada segi teknikal dan kewangan
iii. Perlombongan secara mampan yang mengamalkan amalan terbaik, kawalan kendiri dan tadbir urus korporat
iv. Perlombongan skala besar berteknologi moden
v. Produk-produk ditambah nilai

3.4 Selaras dengan saranan Yang Berhormat Menteri Tenaga dan Sumber Asli untuk melihat pembangunan industri perlombongan dibuat secara mampan dan mengambilkira aspek pemeliharaan alam sekitar,

oleh itu pegawai yang dilantik adalah diingatkan agar melaksanakan tugas dengan kuasa yang telah diperuntukkan secara tegas jika berlaku sebarang ketidakpatuhan.

3.5 JMG juga diminta memberikan penekanan terhadap aspek penguatkuasaan lombong serta mengambil tindakan perundangan seperti mengenakan kompaun atau pendakwaan ke atas mana-mana pemegang tenemen baik syarikat atau individu yang melanggar peruntukan undang-undang perlombongan sedia ada.

3.6 Menurut Pekeliling Ketua Pengarah Galian Malaysia Bil 1/2018, kelulusan SKSPM dibuat secara bersama di dalam jawatankuasa yang dipengerusikan oleh Pengarah Negeri. Bagi kawasan sensitif seperti huluan muka sauk (*upstream water intake*), ahli jawatankuasa kelulusan SKSPM adalah dianggotai oleh JAS, JPS, PTG, dan agensi-agensi lain yang berkenaan. Tetapi, bagi kawasan tidak sensitif ahli jawatankuasa kelulusan SKSPM hanya terdiri daripada Timbalan Pengarah Unit Pembangunan Lombong dan Kuari, Timbalan Pengarah Unit Sumber Mineral dan Timbalan Pengarah Unit Geosains.

3.7 Berdasarkan kepada pindaan Pekeliling Ketua Pengarah Bil 1/2018 tersebut, permohonan baharu SKSPM bagi kawasan sensitif akan dipertimbangkan oleh Jawatankuasa SKSPM Ibu Pejabat yang dipengerusikan Ketua Pengarah dan termasuk permohonan pembaharuan kecuali bagi kawasan sensitif (c) dan (d).

4. PROSEDUR PELAKSANAAN

4.1 Permohonan SKSPM bagi kawasan sensitif akan dibawa ke Ibu Pejabat untuk pertimbangan oleh Jawatankuasa yang dipengerusikan oleh Ketua Pengarah;

4.2 Konsultan dan pemohon/ wakil pemohon akan membuat pembentangan skim melombong yang dicadangkan dan perlu menghadiri sesi soal jawab;

4.3 Satu (1) salinan permohonan SKSPM, laporan ringkas JMG negeri mengenai permohonan dan dokumen Skim Pengendalian Melombong kawasan sensitif hendaklah dikemukakan kepada Ketua Pengarah dalam bentuk cetakan dan digital (*hardcopy* dan *softcopy*) dalam tempoh satu (1) minggu sebelum tarikh mesyuarat Jawatankuasa SKSPM Ibu Pejabat.

4.4 Mesyuarat Jawatankuasa SKSPM Ibu Pejabat akan diadakan sekurang-kurangnya 2 kali sebulan atau mengikut keperluan iaitu pada minggu pertama dan minggu ketiga setiap bulan;

4.5 Cawangan PPO dipertanggungjawabkan sebagai Urusetia bagi Jawatankuasa SKSPM Ibu Pejabat;

4.6 Walaubagaimanapun, sekiranya didapati permohonan tidak menepati kriteria kawasan sensitif, Ketua Pengarah boleh mengembalikan semula permohonan tersebut untuk diproses oleh JMG negeri berkenaan;

5. ARAHAN PEMAKAIAN

5.1 Pekeliling ini hendaklah sentiasa dipatuhi dan dilaksanakan oleh semua pegawai yang dilantik dan berkuatkuasa 1 Julai 2020.

5.2 Pekeliling ini meminda Pekeliling Ketua Pengarah Bil 1/2018 bagi bahagian mengenai pertimbangan SKSPM untuk kawasan sensitif seperti dalam tafsiran.

5.3 Pekeliling ini melengkapi dan tidak mengatasi peruntukan-peruntukan di dalam Akta Pembangunan Mineral 1994 dan peraturan-peraturan di bawahnya.

5.4 Setiap Pengarah Negeri adalah dipertanggungjawabkan untuk melaksanakan pekeliling ini.

6. HAL-HAL LAIN

6.1 Pekeliling ini boleh digunapakai untuk permohonan Lesen Memproses Mineral:

a) terpusat; dan
b) kendiri (*standalone*) yang terletak sebagai Kawasan Sensitif Alam Sekitar.

6.2 Peranan dan penglibatan konsultan akan digunakan sepenuhnya yang mana mereka hendaklah membuat pembentangan, pemantauan, pengesahan dan perakuan selamat untuk beroperasi.

(DATUK SHAHAR EFFENDI BIN ABDULLAH AZIZI)
Ketua Pengarah Galian
Jabatan Mineral dan Geosains Malaysia.

bertarikh: 1/7/2020

Appendix 6-1

DETAILS OF THE PROCEDURAL STEPS FOR THE EIA PROCESS

DETAILS OF THE PROCEDURAL STEPS FOR THE EIA PROCESS

APPENDIX 6-1

1.0 INTRODUCTION

Environmental Impact Assessment (EIA) is a range of actions to identify, predict, evaluate and assess the impacts, both beneficial and adverse with the main objective of protecting the environment and the surrounding areas where the project is located. EIA report contains information for the Project Proponent to implement the mitigation measures in an environmentally friendly and socially responsible manner, while the relevant government agencies (GAs) to make informed decisions on a project, including preparation of the Conditions of Approval (COA). At the same time the Public to understand the project and its potential impact on the environment.

The objective of the EIA study is to ensure that all impacts, direct and indirect, especially environmental, social and economics associated with the proposed development is fully examined and addressed. Consistent with this objective, the EIA report shall be a self-contained and comprehensive document which provides:

- ✧ For the general public, a basis for understanding the proposal, alternatives and preferred solutions, the existing environment and the potential changes to the environment that may occur if the proposal is implemented;
- ✧ For decision maker, information for assessing the proposed development and likely impacts of all associated development with respect to environment, legislative and policy provisions; and
- ✧ For the project initiator, a comprehensive set of environmental requirements are incorporated in the project from planning stage to the end of project.

2.0 ENVIRONMENTAL IMPACT ASSESSMENT REQUIREMENTS

The right to mine of the holder of ML / PML for Ion-Adsorption REE mining and processing is contingent on obtaining approval of EIA as prescribed in Section 64(1)(c), State Mineral Enactment. For Ion-Adsorption REE mining, the activity is a prescribed activity 8, Schedule 2 of EIA Order 2015, Environmental Quality Act 1974.

Section 34A of the Environmental Quality (Amendment) Act 1985 states that any person intending to carry out any of the prescribed activities need to submit an Environmental Impact Assessment (EIA) report to the Director General of the Department of Environment (JAS) and get it endorsed before any approval for carrying out such activity can be granted by the relevant approving authority.

2.1 Prescribed Activity 8, Schedule 2

REE mining and processing operation is a prescribed activity 8, Schedule 2, Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015. Thus, requiring the submission of EIA report to JAS for approval. Activity 8, Schedule 2 is referring to the following:

- ✧ Mining of minerals in new areas involving large scale operation – Under the Environmental Impact Assessment Guidelines for Mining and Quarrying (2018), large scale is defined as that definition of large scale mining in Section 2(1), State Mineral Enactment.
- ✧ Mining of minerals within or adjacent or near to environmentally sensitive areas – The following quantum can be applied to ascertain the definition of adjacent or near. However thorough modelling and impact assessment should be carried out to ensure that the mining activities shall cause adverse impacts to the nearest receptors. Definition of the following terms shall be applicable:

    - ❑ Within – Inside of Environmentally Sensitive Areas of Ranks 1, 2 and Rank 3.
    - ❑ Near – Sharing a boundary with Environmentally Sensitive Areas of Rank 1, 2 and 3.
    - ❑ Adjacent – Project Site is within 500m of Environmentally Sensitive Areas of Rank 1, 2 and 3.

2.2 Prescribed Activity (Others)

Depending on the location of the proposed mine, other than Activity 8, Schedule 2, REE mining operation may also be subjected to other Prescribed Activity as follows:

- ❑ Activity 5, Second Schedule, Forestry
  Conversion of forest at 300 m or more above mean sea level to other land use covering and area of 100 ha or more.
- ❑ Activity 13, First Schedule, Development in Slope Area
  Development or land clearing less than 50% of an area with slope greater than or equal to 25^0 but less than 35^0.

The said report needs to be prepared in accordance with the guidelines prescribed by the Director General and contains an assessment of the impact of such activity on the environment and to propose measures to be undertaken to prevent, reduce, or control the adverse impact on the environment. The preparation of this EIA Report is to ensure that the environmental feasibility of the project is determined, and that environmental management considerations are taken into account during the project formulation period.

2.3 EIA Guidelines

The preparation, submission of an EIA for REE mining and processing is based on a number of guidelines produced by Jabatan Alam Sekitar (JAS), notably the Environmental Impact Assessment Guidelines in Malaysia (2016) and Environmental Impact Assessment Guidelines for Mining and Quarrying (2018). Other related guidelines on EIA issued by JAS Department of Environment which also need to be closely consulted are as follows:

- ✧ Guidance Document for Addressing Soil Erosion and Sediment Control Aspects in the Environmental Impact Assessment (EIA) Report (JAS 2016)
- ✧ Guidance Document for the Preparation of The Document on Land-Disturbing Pollution Prevention and Mitigation Measures (LDP2M2) (JAS 2016)
- ✧ Guidance Document on Health Impact Assessment (HIA) in Environmental Impact Assessment (EIA) (JAS 2012)
- ✧ Guideline for Erosion and Sediment Control in Malaysia, 2010.
- ✧ Urban Stormwater Management Manual for Malaysia (MSMA) 2nd Edition, 2012.
- ✧ The Planning Guidelines for Environmental Noise Limits and Control, (2nd Edition) (JAS 2007).

2.4 Compatibility with Local Planning Strategies

Section 34A, Environmental Quality Act 1974 stipulates that the Director General of Environment may only approved an EIA for a particular project which is in line with the Local Plan of the area. Thus, it is pertinent on the part of the Project Proponent or the project Approving Authorities to take into consideration the status of the land under consideration. In practice, JAS would like matters pertaining to the zoning issues of the project area be settled at the TOR stage of the EIA process.

2.5 Mine Buffer Zone

According to JAS latest Guidelines for Siting and Zoning for Industries, the required buffer zone for a mine to the nearest receptor within the settlement area is 500 m. Thus, under the site suitability requirement, adequate buffer zone need to be provided particularly to

the nearest sensitive receptor located within 500 m radius of the project boundary. Due care must be observed and the best environmental management practice need to be implemented in the operation of the mine.

3.0 PROCEDURAL STEPS FOR ENVIRONMENTAL IMPACT ASSESSMENT

The EIA and its review process are based on the Environment Impact Assessment Guidelines in Malaysia (2016) published by JAS. It provides assessors with a step-by-step guide to the process of an EIA. A Term of Reference (TOR) for the EIA shall be prepared and submitted for endorsement before the commencement of the EIA study. Flow path for the EIA is as shown in **Figure 1**.

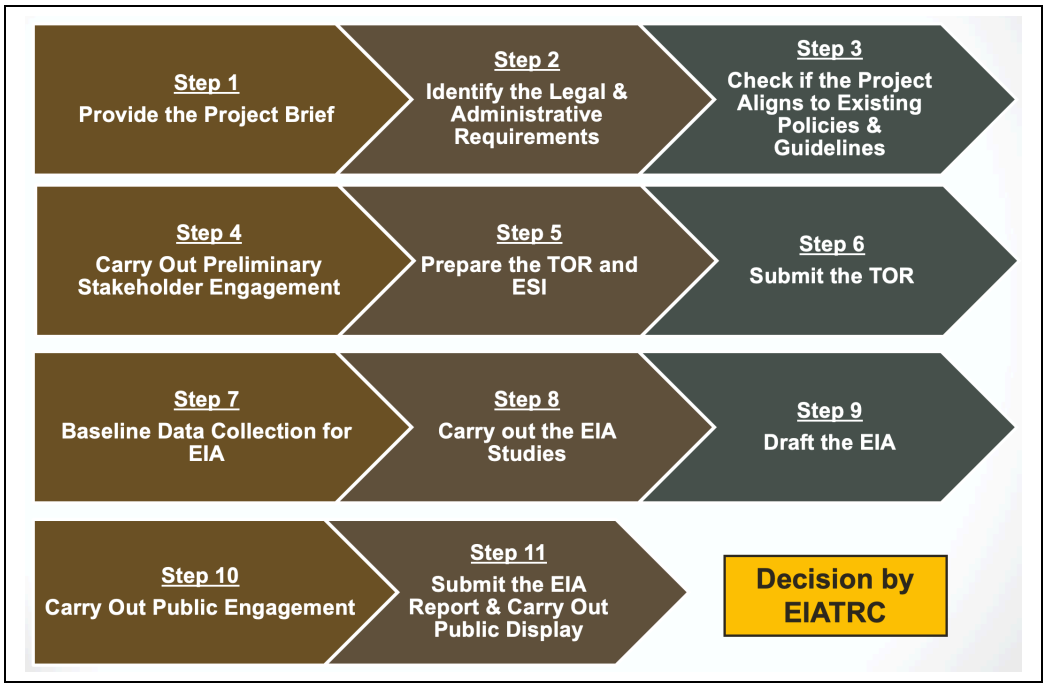
3.1 EIA Study to be Conducted by Qualified Person

An EIA study shall only be carried out by a team of Qualified Persons who hold a valid registration with JAS as stipulated under Section 34A (2B) of the EQA 1974 (Amendment) 2012. The Qualified Persons are commonly referred to as the EIA Consultants. The EIA team shall comprise professionals (qualified persons) who are competent and experienced in the technical fields relevant to the EIA study. The team shall be led and supervised by a team leader who shall be responsible for coordinating the EIA study and for ensuring the EIA Report to be written is complete, clear, coherent, balanced, and impartial and is useful for decision making process.

3.2 EIA Methodologies

EIA study shall follow the following typical steps or phases commonly followed by EIA practitioners and widely adopted by environmental agencies worldwide:

- ✧ Screening
- ✧ Scoping towards formulation of terms of reference
- ✧ Baseline study
- ✧ Identification of mitigation measures
- ✧ Impact assessment and evaluation of significance
- ✧ EIA Report preparation
- ✧ EIA Report review
- ✧ Decision making
- ✧ Project implementation and environmental monitoring
- ✧ Environmental audit



Source: JAS (2016)

Figure 1: Flow Path for the Environmental Assessment

3.3 The Environmental Scoping Information

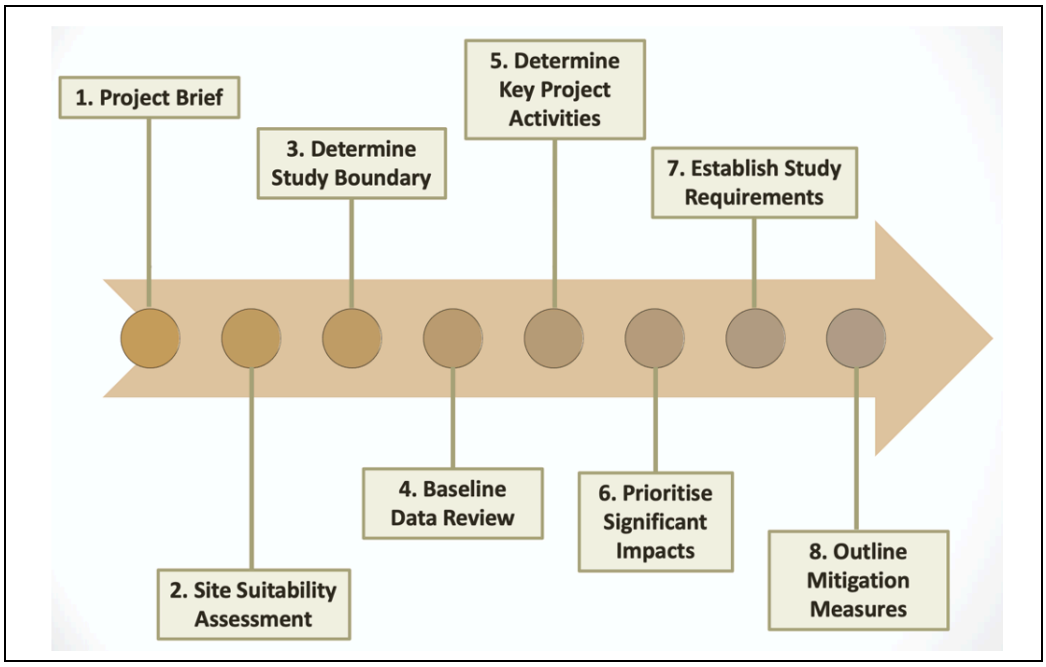
The Environmental Scoping Information (ESI) shall provide further elaboration to the Terms of Reference, by demonstrating to JAS that the Project Proponent has given due consideration to the proposed project and the potential environmental issues that may result from the development and operation of the Project. Summary of the environmental scoping process is as shown in **Figure 2**.

Scoping is a critical activity which is required at the early stage in the EIA process. It is designed to identify and assess the key environmental impacts and issues of concern that are required to be considered in detail during the EIA for the project. Scoping shall ensure that matters which are of most importance are addressed in most detail and valuable resources are not spent on non-significant matters. Thus, project brief that is information from Project Proponent to Qualified Person is an important ESI to facilitate Environmental Screening and Scoping which serves as overview of the project.

3.4 Terms of Reference (TOR) Formulation

TOR is the product of the scoping process. The scoping identifies the issues to be addressed, whereas the TOR sets the objectives, defines the scope, and establishes the strategy and schedule for the EIA process to address these issues. Typically, the TOR

will define what types of information obtained from the scoping process are to be presented in the EIA Report as follows:



Source: JAS (2016)

Figure 12: Summary of the Environmental Scoping Process

- ✧ To specify what studies will be performed,
- ✧ Identify who will conduct the studies,
- ✧ State when the studies will be carried out and the study timeline,
- ✧ Outline the methodologies to be used in impact assessment and evaluation of significance.

3.5 Baseline Studies

A baseline study is the study of the current status of the environment in the area proposed for development before the development work of the project is started. The baseline study phase may involve field studies (the collection of data directly from the project site – primary sources) or desktop studies (data obtained from published records, project documents, maps, photos – secondary sources). The baseline study will identify key issues likely to be faced as a result of the implementation of the proposed project. The baseline studies will provide a detailed description of the affected area and establish the existing environmental and socioeconomic baseline status that will be used in the impact assessment phase.

3.6 Impact Assessment and Evaluation of Significance

During the impact assessment phase of the EIA study, the impacts of the proposed project are determined. The impacted sectors could be environmental, socio-economic, health, etc. To identify and assess the magnitude of potential impacts associated with or resulting from project activities, a number of methodologies have been developed and used worldwide. These include the following:

- ✧ Experts judgement
- ✧ Checklist and matrices
- ✧ Multi-criteria analysis
- ✧ Mathematical models and simulation
- ✧ Case comparison
- ✧ Geospatial analysis
- ✧ Risk analysis

3.7 Identification of Mitigation Measures

This step of the EIA study will identify mitigation measures that can be implemented to avoid, prevent, minimize, or offset the predicted adverse impacts. The environmental agencies normally require that state of the art technologies or best available technologies (BAT) and industry best practices appropriate to the project components are evaluated for implementation to mitigate the adverse environmental impacts on the various receptors. Mitigation measures include all actions and activities taken, put in place, or executed which could be structural, non-structural, procedural, or administrative in nature, to mitigate the adverse impacts.

3.8 EIA Report Preparation

Based on the results of all studies, the EIA team leader will coordinate the writing of the EIA Report and thoroughly review it to ensure it encompasses all the elements in the TOR, and is comprehensive, coherent, balanced, impartial and technically acceptable for submission to the authorities. The EIA consultant acting as the team leader shall extract and summarize the major findings of the reports prepared by subject matter consultants (SMCs) and place them in the appropriate chapters in the EIA Report. The report summary made by the EIA consultant shall be cross referenced to the relevant pages in the SMCs' reports. The original reports by the SMCs shall be placed in the Appendix to EIA report.

4.0 FINAL EIA REPORT DOCUMENTATION

Guidance Document for Preparing Terms of Reference (TOR) issued by Jabatan Alam Sekitar has clearly prescribed the contents of the EIA Report. The EIA Report shall be concise and limited to significant environmental issues and must provide all the relevant information needed by the regulatory agencies to consider fully any adverse or beneficial impacts of the proposal.

It is envisaged that the EIA will be based on the results of available research (including any preliminary results from research through consultation with research organizations), studies and data as appropriate, with further studies being conducted where necessary and practicable. The extent to which the limitations, if any, of available information may influence the conclusions of the environmental assessment shall be discussed.

4.1 Contents of EIA Report

The main text shall focus on findings, conclusions and recommended actions, supported by summaries and analyses of the data collected, as well as citations for any references used in their interpretation. Unpublished documents and detailed data must be presented in appendices. Where the EIA utilises the results of previously conducted research, appropriate references and a listing of individuals and organisations consulted must be included. The public availability of data and studies utilised shall also be indicated. Methodologies for all data collection and analyses (including quality control measures) must be included in relevant appendices.

Wherever practical, maps, flow diagrams, charts and photographs directly referred to in the main text shall be included in the relevant section of the main body of the document.

The introduction to the EIA shall provide an explanation of the scope of the proposal and the issues and decisions which led to the proposal at this time and in this context — including a history of events leading up to project formulation and alternatives considered, envisaged time scale for implementation and project life, anticipated establishment costs and actions already taken at the project site. The introduction shall also briefly describe the study area and regional setting for the proposal (with reference to any maps as appropriate), including land use and tenure, and describe the studies/surveys/consultations that have been conducted in developing the proposal and preparing the EIA. The complete studies and detailed comments resulting from consultations must be included as appendices. The EIA shall provide a listing and description of the approvals needed for the proposal to proceed.

4.2 Chapters of the EIA Report

A suggested Table of Contents of the EIA Report as detailed in JAS EIA Guidelines are as follows:

- ✧ Project Proponent's Declaration
- ✧ Consultant's Declaration
- ✧ Executive Summary in Bahasa Malaysia and English
- ✧ Chapter 1: Introduction
- ✧ Chapter 2: Terms of Reference of EIA Study
- ✧ Chapter 3: Statement of Need
- ✧ Chapter 4: Project Options
- ✧ Chapter 5: Project Description
- ✧ Chapter 6: Existing Environment
- ✧ Chapter 7: Evaluation of Impacts
- ✧ Chapter 8: Mitigation Measures
- ✧ Chapter 9: Environmental Management Plan (EMP)
- ✧ Chapter 10: Study Findings
- ✧ References
- ✧ Appendices

Environmental assessment requires interdisciplinary analysis. Experts in their relevant fields should interpret information obtained and where necessary, appropriate references and technical/scientific analyses shall be provided to support such interpretations. This shall also apply to social issues, especially when dealing with sensitive matters.

In order to aid the review process, the following information should be submitted to JAS:

- ✧ The soft copy version (portable document format - PDF) of the Executive Summary shall be submitted to JAS (EIA Secretariat) and also to the State JAS office.
- ✧ Soft copy of the full EIA Report to JAS (EIA Secretariat). The softcopy will be uploaded to the Enviro Knowledge Management Centre (EKMC) and website of JAS for public display.

These will be copied and used for the public comment process, as well as being available to other departments/agencies that would have a critical role in the evaluation of the report.

Appendix 7-1

SUSTAINABLE DEVELOPMENT INDICATOR (SDI)
AUDITING FORMAT AS DESIGNED BY JMG

JABATAN MINERAL DAN GEOSAINS MALAYSIA

BORANG AUDIT KEMAMPANAN

Nama Lombong/Kuari : _____

No. SKSPM/SKSK : _____

Nama Pelesen : _____

Tarikh Audit : _____

Nama Wakil Syarikat : _____

Nama Juruaudit :

Nama	Jawatan	Tandatangan
1.		
2.		
3.		
4.		
5.		
6.		

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
1.0	**PEMATUHAN (COMPLIANCE) -** *Pematuhan kepada perundangan dan peraturan.* **MARKAH: 60%**							
1.1	**Surat Kelulusan Skim Pengendalian Melombong (SKSPM) / Surat Kelulusan Skim Pengkuarian (SKSK)** Kesahan SKSPM / SKSK	Sek. 10 (APM 1994), Kaed. 4 (KKK)		☐ Pembaharuan dibuat selepas tempoh luput	☐ Masih sah dan pembaharuan di luar tempoh yang dibenarkan	☐ Masih sah. Jika telah luput, pembaharuan dalam tempoh yang dibenarkan		
1.2	**Pengubahsuaian Skim** Mendapat kelulusan	Sek. 11 (APM 1994)		☐ Telah kemuka dan telah mula membuat pengubahsuaian	☐ Telah kemuka dan belum membuat pengubahsuaian	☐ Telah diluluskan atau telah kemukakan dan belum membuat pengubahsuaian serta memaklumkan pelaksanaan kerja		
1.3	**Pelan** Mengemukakan pelan pengerjaan yang disahkan oleh Jurutera Perunding	Sek. 16 (APM 1994), Kaed. 10 (KKK)		☐ Ada kemuka	☐ Ada kemuka dan dikemaskini	☐ Ada, dikemaskini dan boleh ditunjukkan apabila diminta	*Pelan dikemaskini setiap 6 bulan dan boleh ditunjukkan apabila diminta oleh Pegawai Galian*	
1.4	**Arahan Pengurus (Manager's instruction)** Mempunyai Arahan Pengurus berkenaan keselamatan dan kesihatan pekerjaan	Sek. 15 (APM 1994), Kaed. 8 (KKK)		☐ Ada	☐ Pamer	☐ Laksana	*1. Mempunyai arahan bertulis oleh Pengurus berkenaan keselamatan dan kesihatan pekerjaan* *2. Dipamerkan di pejabat dan tempat-tempat pekerja berkumpul (cth bengkel, kantin, makmal dll)* *3. Bukti pelaksanaan melalui rekod (buku log, minit mesyuarat, toolboxs talks, rekod denda)*	*Untuk lombong jika diarah oleh Penolong Pengarah Galian. Bagi kuari, melainkan jika dikecualikan, mesti dikemukakan dalam tempoh 1 bulan selepas SKSK diluluskan.*
1.5	**Buku Rekod (Record books)** Mempunyai rekod pemeriksaan yang kemaskini dalam aturan dan keadaan yang baik, tersedia untuk diperiksa.	Sek.17 (APM 1994), Kaed. 9(KKK)		☐ Ada dan disimpan oleh Pengurus	☐ Ada, simpan dan dikemaskini	☐ Mempunyai buku rekod yang teratur, dikemaskini dan disahkan oleh pengurus	*Buku Rekod dalam bentuk helaian kertas (hardcopy)* *Butiran kandungan buku rekod* ▪ *Lombong – pemeriksaan keselamatan, pengawasan kawalan pencemaran*	*Pemeriksaan direkodkan oleh orang yang kompeten dan disahkan sekurang-kurangnya setiap 10 hari oleh pengurus. Buku rekod perlu berada dalam simpanan pengurus. Kemaskini bermaksud*

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
							▪ *Kuari – pemeriksaan keselamatan, pengawasan kawalan pencemaran,rekod peletupan.*	*pengesahan terakhir oleh pengurus.*
1.6	**Peralatan Perlindungan Diri *(Personal Protective Equipments)*** Dibekalkan dan digunakan oleh pekerja mengikut kesesuaian tempat	Per. 5(1)(f) (PPPM KSPPP), Kaed. 17 (KKK)		☐ Dibekal tetapi hanya diguna sebilangan kecil (<50%))	☐ Dibekal tetapi sebahagian menggunakannya (50%<W<90%)	☐ Dibekal dan dipakai lebih 90%	*Penilaian berasaskan kepada tempat kerja seperti muka kuari, lombong, loji pemproses, bengkel, makmal, kawasan hampas. Pembekalan PPE boleh disemak melalui rekod stor.*	
1.7	**Kawasan Muka Kerja** Memastikan muka kerja yang selamat dan stabil	Per. 5 (PPPM KSPPP), Kaed.14(2) (KKK)		☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 1 hingga 3 indikator tambahan	☐ Memenuhi indikator mandatori dan mana-mana sekurang-kurangnya 4 indikator tambahan.	**INDIKATOR MANDATORI** ☐ Cerun keseluruhan (<45° untuk lombong, ,<1:1.5 untuk kuari) ☐ Lebar dan tinggi tetingkat– Minimum lebar: 5m, maksimum tinggi: 15m (terpakai kepada lombong dan kuari) ☐ Tiada rekahan tegangan (tensional crack) atau batu tergantung ☐ Ada laluan kecemasan **INDIKATOR TAMBAHAN** ☐ Ketirisan terkawal, keadaan air yang keluar ☐ Sistem kawalan pemendapan kelodak yang mencukupi ☐ Keadaan lantai yang rata ☐ Jalan pengangkutan (lebar, kecondongan, penyenggaraan) ☐ Pematuhan sistem pengurusan trafik ☐ Sistem perparitan ☐ Lain-lain, nyatakan_____	
1.8	**Pemprosesan Mineral *(Heap / Vat Leaching Process)*** ∗ *Dikecualikan untuk operasi kuari*	Per. 5 (PPPM KSPPP)		☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 1 hingga 2 indikator tambahan	☐ Memenuhi indikator mandatori dan mana-mana sekurang-kurangnya 3 indikator tambahan.	**INDIKATOR MANDATORI** ☐ Longgokan mengikut spesifikasi yang diluluskan ☐ Kawalan kebocoran pad ☐ Alat pengesan gas HCN **INDIKATOR TAMBAHAN** ☐ Sistem kawalan kebocoran (tubewell, piezometer) ☐ SOP kebocoran ☐ PPE khas ☐ Papan tanda amaran ☐ Penyenggaraan berkala ☐ Pad berbumbung ☐ Sistem perparitan ☐ Lain-lain, nyatakan_____	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
1.9	**Pengurusan Sisa -** Penilaian dari segi rekabentuk yang selamat dan stabil							
	i. Kawasan longgokan hampas kering	Per. 9(1) (PPPM KSPPP), Kaed. 26 (KKK)		☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 1 hingga 2 indikator tambahan	☐ Memenuhi indikator mandatori dan mana-mana sekurang-kurangnya 3 indikator tambahan.	**INDIKATOR MANDATORI** ☐ Cerun keseluruhan (<60^{0}untuk lombong,) ☐ Tinggi longgokan – maksimum 10 meter kecuali dengan kebenaran ☐ Sistem kawalan air larian permukaan ☐ Sistem kawalan air larut resapan (untuk bijih sulfida) ☐ Sistem kawalan hakisan tanah **INDIKATOR TAMBAHAN** ☐ Bonggol sisi (tip edge berm) ☐ Tingkatan (bench) setiap 3 meter ☐ Sistem kawalan habuk ☐ Sistem perparitan ☐ Ada laluan kecemasan ☐ Jalan pengangkutan (lebar, kecondongan, penyenggaraan) ☐ Pematuhan sistem pengurusan trafik ☐ Lain-lain, nyatakan_____	
	ii. Kemudahan penyimpanan hampas basah *(Tailings storage facilities)*	Per. 9(1) (PPPM KSPPP), Kaed. 26 (KKK)		☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 1 hingga 2 indikator tambahan	☐ Memenuhi indikator mandatori dan mana-mana sekurang-kurangnya 3 indikator tambahan.	**INDIKATOR MANDATORI** ☐ Penyelenggaraan cerun ban ☐ Basi bidang (Free board) – tidak kurang 1 meter ☐ Alur limpah (spillway) – berfungsi dan kekal ☐ Isipadu kawasan hampas basah mencukupi ☐ Sistem kawalan air larian permukaan **INDIKATOR TAMBAHAN** ☐ Alur limpah konkrit ☐ Sistem kawalan air larut resapan ☐ Sistem kawalan hakisan tanah ☐ Sistem pemantauan paras air (water table) ☐ Pembuangan efluen melalui alur limpah yang dibenarkan ☐ Syarat sistem litar tertutup atau tiada pembuangan efluen, jika berkenaan ☐ Lain-lain, nyatakan_____	
1.10	**Pengurusan Stokpil -** Penilaian dari segi rekabentuk yang selamat dan stabil							
	• Kawasan longgokan stokpil			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 1	☐ Memenuhi indikator mandatori dan mana-mana	**INDIKATOR MANDATORI** ☐ Cerun keseluruhan (kurang dari 45^o) ☐ Tinggi longgokan – maksimum 6 meter kecuali dengan kebenaran	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
					hingga 2 indikator tambahan	sekurang-kurangnya 3 indikator tambahan.	☐ Sistem kawalan air larian permukaan ☐ Sistem kawalan air larut resapan (untuk bijih sulfida sahaja) ☐ Sistem kawalan hakisan **INDIKATOR TAMBAHAN** ☐ Bonggol sisi *(tip edge berm)* ☐ Sistem kawalan habuk (sprinkler, bertutup, penghadang dll) ☐ Ada laluan kecemasan ☐ Jalan pengangkutan (lebar, kecondongan, penyenggaraan) ☐ Pematuhan sistem pengurusan trafik ☐ Kedudukan jauh dari kepentingan awam ☐ Lain-lain, nyatakan_____	
1.11	**Pengurusan Efluen *(Effluent Management)* -** Memastikan air buangan dari lombong mengikuti piawaian yang ditetapkan.							
	Melaksanakan kawalan hakisan dan pemendapan kelodak	Sek. 18 (APM 1994), PPPM Efluen, Kaed. 26 (KKK)		☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 1 hingga 2 indikator tambahan	☐ Memenuhi indikator mandatori dan mana-mana sekurang-kurangnya 3 indikator tambahan.	**INDIKATOR MANDATORI** ☐ Rancangan kawalan hakisan (perlu rujuk skim melombong/ kuari) ☐ Kolam pemendapan kelodak ☐ Alur limpah (spillway) ☐ Perangkap kelodak ☐ Penyelengaraan ☐ Parit ☐ Zon penampan (10m) **INDIKATOR TAMBAHAN** ☐ Pensampel yang kompeten ☐ Pagar kelodak *(silt fence)* ☐ Stesen perawatan air sisa ☐ Pemantauan kualiti efluen ☐ Alur limpah (*spillway*) – berfungsi dan diselenggara ☐ Kaedah mengurangkan hakisan (contoh; program penghijauan,*turfing*,*mat*s dan sebagainya) ☐ Lain-lain, nyatakan_____	
1.12	**Bahan Api** Penyimpanan bahan api (petrol, disel, LPG, CNG)	Sek. 8(1)(a) (APM 1994), Kaed. 22 (KKK)		☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 1 hingga 2 indikator tambahan	☐ Memenuhi indikator mandatori dan mana-mana sekurang-kurangnya 3 indikator tambahan.	**INDIKATOR MANDATORI** ☐ Mempunyai lesen membeli, menyimpan dan mengguna yang sah ☐ Prosedur Operasi Standard (SOP) ☐ Alat pemadam api (masih mempunyai tempoh sah) **INDIKATOR TAMBAHAN** ☐ Pengudaraan (pemerhatian fizikal)	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
							☐ Buku stok keluar masuk (dikemaskini dan disimpan dengan elok) ☐ Struktur binaan stor (berpagar, berbumbung, dan berkunci) ☐ Mempunyai kemudahan stor ☐ Lokasi stor yang bersesuaian ☐ Kebersihan dan kekemasan ☐ Papan tanda ☐ Kaedah penyimpanan dan susunatur bahan ☐ Pegawai bertanggungjawab ☐ Kaedah pelupusan bahan-bahan ☐ Zon penampan ☐ Sistem kawalan kebocoran/tumpahan (takungan tumpahan konkrit) ☐ Lain-lain, nyatakan_____	
1.13	**<u>Bahan Berbahaya</u>** Penyimpanan bahan-bahan berbahaya. *Dikecualikan untuk operasi kuari*	Sek. 8(1)(a) (APM 1994), Akta Racun1952 [Section 26(2)],		☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 1 hingga 2 indikator tambahan	☐ Memenuhi indikator mandatori dan mana-mana sekurang-kurangnya 3 indikator tambahan.	**<u>INDIKATOR MANDATORI</u>** ☐ Mempunyai lesen membeli, menyimpan dan mengguna yang sah (Sianida, Hidrogen Peroksida dll) ☐ Prosedur Operasi Standard (SOP) untuk sianida dan bahan kimia, jika berkaitan ☐ Alat pemadam api (masih mempunyai tempoh sah) **<u>INDIKATOR TAMBAHAN</u>** ☐ Pengudaraan (pemerhatian fizikal) ☐ Buku stok keluar masuk (dikemaskini dan disimpan dengan elok) ☐ Struktur binaan stor (berpagar, berbumbung, dan berkunci) ☐ Mempunyai kemudahan stor ☐ Lokasi stor yang bersesuaian ☐ Kebersihan dan kekemasan ☐ Papan tanda ☐ Kaedah penyimpanan dan susunatur bahan ☐ Pegawai bertanggungjawab ☐ Kaedah pelupusan bahan-bahan ☐ Zon penampan ☐ Sistem kawalan kebocoran/tumpahan (takungan tumpahan konkrit) ☐ Menyediakan *'emergency shower'* ☐ Lain-lain, nyatakan_____	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
1.14	**Pelan Pengurusan Keselamatan (Safety Management Plans)** *Menjalankan kerja penjelajahan dan di lombong permukaan dengan selamat.*	(PPPM KSPPP), Bhg. III (KKK)		☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 1 hingga 2 indikator tambahan	☐ Memenuhi indikator mandatori dan mana-mana sekurang-kurangnya 3 indikator tambahan.	**INDIKATOR MANDATORI** ☐ SOP Keselamatan ☐ Melantik pegawai kompeten yang bertanggungjawab mengenai pengurusan keselamatan operasi ☐ Menyediakan *First Aid Kit* **INDIKATOR TAMBAHAN** ☐ Mempunyai *'Safety and Health Officer'* (SHO) ☐ Mengemukakan laporan keselamatan ☐ Program latihan keselamatan ☐ Penandaan kawasan berbahaya ☐ Penyediaan *Emergency Respons Plan* (ERP) ☐ Mempunyai pasukan *Emegency Response*(ER) ☐ Mempunyai peralatan menyelamat ☐ Papan tanda kenyataan berkaitan kemalangan ☐ Lain-lain, nyatakan_____	
1.15	**Pelan Pengurusan Peletupan (Blast Management Plan)** *Menjalankan kerja peletupan dengan selamat.*	PPPM (Peletupan) 2013 Kaed. 20 (KKK)		☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 1 hingga 2 indikator tambahan	☐ Memenuhi indikator mandatori dan mana-mana sekurang-kurangnya 3 indikator tambahan	**INDIKATOR MANDATORI** ☐ SOP Peletupan / Blast Monitoring Plan (BMP) ☐ Perlantikan Pembedil **INDIKATOR TAMBAHAN** ☐ Tiada aduan yang berasas ☐ Menjalankan pengukuran tahap gegaran bumi dan ledakan udara bagi setiap peletupan ☐ Menyimpan rekod kerja-kerja peletupan (buku log pembedil) ☐ Mengemukakan laporan bulanan kerja pemantauan ☐ Pematuhan ke atas had yang dibenarkan bagi gegaran bumi dan ledakan udara ☐ Pemberitahuan kerja letupan kepada orang awam (*Public engagement*) ☐ Penggunaan peralatan tertentu untuk mengurangkan impak kerja letupan (contoh *blasting mat*) ☐ Lain-lain, nyatakan_____	
1.16	**Pengemukaan Laporan Statistik** Laporan dikemukakan pada atau sebelum 10hb bulan berikutnya	Sek. 8(2) (APM 1994)(Syarat-syarat SKSPM) Kaed. 11 (KKK)		☐ Telah kemuka tetapi lewat atau tidak lengkap	☐ Kemuka lewat tetapi lengkap	☐ Kemuka mengikut tempoh yang ditetapkan dan lengkap		

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
1.17	**Sempadan (Boundary)** Mempunyai tanda sempadan dan menyelenggarakannya dengan baik.	Pematuhan SKSPM dan SKSK		☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 2 indikator tambahan	☐ Memenuhi indikator mandatori dan mana-mana 4 indikator tambahan.	**INDIKATOR MANDATORI** ☐ Mengekalkan tanda sempadan di semua titik rujukan (dengan batu sempadan, pancang dll) **INDIKATOR TAMBAHAN** ☐ Tanda sempadan mudah dilihat ☐ Menyelenggara tanda sempadan dengan baik. ☐ Jarak tanda sempadan yang bersesuaian ☐ Mempunyai akses yang senang ke tanda sempadan ☐ Menyediakan pagar disepanjang sempadan ☐ Memasang papan tanda amaran kawasan lombong atau kuari ☐ Memelihara jarak zon penampan sempadan (10 meter) ☐ Lain-lain, nyatakan_____	
1.18	**Zon Penampan Sempadan** Tiada pengorekan, longgokan dan pemprosesan 10 meter di dalam dari sempadan lombong/kuari	Pematuhan SKSPM dan SKSK		☐ Telah kemuka permohonan tetapi belum mendapat kelulusan dan telah memulakan aktiviti	☐ Permohonan telah diluluskan untuk aktiviti di zon penampan	☐ Tiada sebarang aktiviti di kawasan zon penampan		
1.19	**Zon Penampan Tebing Sungai** Tiada pengorekan, longgokan dan pemprosesan dalam jarak minimum 20 meter dari tebing sungai			☐ Telah kemuka permohonan tetapi belum mendapat kelulusan dan telah memulakan aktiviti	☐ Permohonan telah diluluskan untuk aktiviti di zon penampan	☐ Tiada sebarang aktiviti di kawasan zon penampan	***Nota:*** *Terpakai jika aktiviti dijalankan berhampiran dengan sungai*	
1.20	**Pemulihan kawasan yang telah dikerjakan** Peninggalan lubang dan muka lombong/kuari			☐ Distabilkan sahaja	☐ Distabilkan dan dijadikan selamat	☐ Distabilkan, dijadikan selamat dan dipulihkan		
	Jumlah Markah Bah. 1.0			_____%				

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
2.0	**AMALAN TERBAIK (BEST PRACTICES) -** *Amalan atau tindakan melebihi dari sepatutnya yang ditetapkan oleh perundangan dan peraturan* **MARKAH: 5%**							
2.1	**Carta Organisasi** Mempamerkan carta organisasi lombong/kuari yang lengkap dan kemaskini.			☐ Pamer	☐ Pamer dan lengkap / Pamer	☐ Pamer carta yang lengkap dan kemaskini bagi tahun semasa	*Carta yang lengkap mengandungi peringkat pengurusan sehingga penyelia dengan menyatakan nama dan jawatan. Kemaskini mengikut tahun semasa dan tertera dalam carta tarikh dikemaskini setiap 6 bulan.*	
2.2	**Papan Tanda** Memasang papan tanda di pintu masuk utama			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 2 indikator tambahan	☐ Memenuhi indikator mandatori dan mana-mana 4 indikator tambahan	**INDIKATOR MANDATORI** ☐ Papan tanda yang dipasang menunjukkan nama dan aktiviti yang dijalankan dengan menggunakan Bahasa Kebangsaan. **INDIKATOR TAMBAHAN** ☐ Mudah dilihat ☐ Menggunakan Bahasa Inggeris ☐ Saiz dan huruf pada papan tanda yang digunakan adalah bersesuaian ☐ Papan tanda yang digunakan menarik perhatian. ☐ Inisiatif mengindahkan papan tanda atau disekitarnya (lanskap) ☐ Maklumat lanjut mengenai syarikat termasuk pemilik, kontraktor, tempoh lesen, maklumat tanah dsb. ☐ Lain-lain, nyatakan_____	
2.3	**Pamer Surat Kelulusan** Mempamerkan Surat Kelulusan Skim Pengendalian Melombong/Skim Kuari beserta pelan yang sah di pejabat lombong/kuari.			☐ Pamer di pejabat	☐ Pamer di pejabat dan mudah dilihat	☐ Pamer di pejabat dan tempat-tempat lain (yang sesuai) serta mudah dilihat	*Tempat lain yang sesuai merujuk kepada kantin, bilik mesyuarat, pondok pengawal.* *Hanya salinan SKSPM/SKSK sahaja yang perlu dipamerkan.*	
2.4	**Program Keselamatan dan Kesihatan Pekerjaan** *Nota: Program atau aktiviti semasa yang dilaksanakan dan aktiviti-aktiviti dalam tempoh 1 tahun sebelum tarikh audit*			☐ Mematuhi indikator mandatori	☐ Mematuhi indikator mandatori dan melaksana mana-mana 1 hingga 3 indikator tambahan	☐ Mematuhi indikator mandatori dan melaksana mana-mana 4 hingga 7 indikator tambahan	**INDIKATOR MANDATORI** ☐ Dasar OSH ☐ Pembentukan Jawatankuasa OSH (Bil pekerja >40 ke atas) ☐ Pelantikan Pegawai (Bil pekerja >100 ke atas) **INDIKATOR TAMBAHAN** ☐ Mengenalpasti risiko kawasan, bahan dan aktiviti bermudarat (HIRARC) ☐ Langkah-langkah pengurangan risiko (HIRARC) ☐ Program latihan keselamatan ☐ Tatacara keselamatan apabila berlaku kemalangan	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
							☐ Tatacara tindakbalas kecemasan (ERP) ☐ Mesyuarat berkala (sekurang-kurangnya setiap 3 bulan) ☐ *Awareness*/Kempen keselamatan ☐ Lain-lain, nyatakan_____	
2.5	**Loji Pemprosesan / Loji Penghancuran** Untuk kesemua loji			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 1 hingga 3 indikator tambahan	☐ Memenuhi indikator mandatori dan mana-mana sekurang-kurangnya 4 indikator tambahan.	**INDIKATOR MANDATORI** ☐ Mempunyai sistem suis pemberhentian kecemasan ☐ Mempunyai tangga dan susur tangan ☐ Mempunyai penghadang bagi peralatan yang bergerak ☐ Mempunyai laluan pejalan kaki ☐ Mempunyai pelantar kerja **INDIKATOR TAMBAHAN** ☐ Mempunyai sistem LOTOTO (*lock out, tag out, try out*) ☐ Mempunyai sistem kawalan habuk ☐ Mempunyai pengesan gas ☐ Mempunyai sistem kawalan hingar ☐ Mempunyai sistem kawalan tumpahan ☐ Kecondongan tangga di antara 15 dan 20 darjah dari sudut pugak ☐ Anak tangga diperbuat dari bahan besi ☐ Tangga diikat (*anchored*) pada sela tidak lebih 3 meter ☐ Tangga mempunyai platfom pada setiap ketinggian pugak 10 meter ☐ Platfom dan tangga tidak mudah gelincir ☐ Lain-lain, nyatakan_____	
2.6	**Kawalan Pencemaran Alam Sekitar** Kawalan Habuk			☐ Mempunyai Pelan/ Langkah-langkah pengurusan alam sekitar lombong / kuari	☐ Mempunyai Pelan/ langkah-langkah pengurusan alam sekitar lombong / kuari dan 2 atau lebih dari indikator tambahan	☐ Mempunyai Pelan/ Langkah-langkah pengurusan alam sekitar lombong / kuari dan 3 atau lebih dari indikator tambahan	**INDIKATOR MANDATORI** ☐ Pelan/ Langkah-langkah pengurusan alam sekitar lombong / kuari **INDIKATOR TAMBAHAN** ☐ Pemantauan habuk menggunakan kaedah DDG atau HVS ☐ Penyembur air di *'drop point'* ☐ Penyemburan air di '*transfer point'* ☐ Penggunaan lori tangki untuk menyembur air di jalan ☐ Loji penghancuran dan penskrinan bertutup ☐ *'conveyer belt'* bertutup ☐ Menurap jalan ☐ *Dust suppression polymer* ☐ Mempunyai Pegawai Alam Sekitaryang kompeten ☐ Lain-lain, nyatakan_____	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
2.7	**Kawalan Pencemaran Alam Sekitar** Kawalan Bunyi Bising			☐ Mempunyai Pelan/ Langkah-langkah pengurusan alam sekitar lombong / kuari	☐ Mempunyai Pelan/ langkah-langkah pengurusan alam sekitar lombong / kuari dan 2 atau lebih dari indikator tambahan	☐ Mempunyai Pelan/ Langkah-langkah pengurusan alam sekitar lombong / kuari dan 3 atau lebih dari indikator tambahan	**INDIKATOR MANDATORI** ☐ Pelan/ Langkah-langkah pengurusan alam sekitar lombong / kuari **INDIKATOR TAMBAHAN** ☐ Dinding penahan bunyi bising *(sound barrier wall)* ☐ Panel pelindung/penyerap bunyi, kurungan (enclosure) ☐ Pemantauan bunyi bising – *penggunaan alat noise dosimeter / sound level meter* ☐ Penanaman pokok-pokok di tempat yang bersesuaian ☐ *Rubberise screen* ☐ Pemasangan *exhaust muffler* pada semua jentera ☐ Lain-lain, nyatakan_____	
2.8	**Kawalan Pencemaran Alam Sekitar** Kawalan Kualiti Air			☐ Mempunyai Pelan/ Langkah-langkah pengurusan alam sekitar lombong / kuari	☐ Mempunyai Pelan/ langkah-langkah pengurusan alam sekitar lombong / kuari dan 2 atau lebih dari indikator tambahan	☐ Mempunyai Pelan/ Langkah-langkah pengurusan alam sekitar lombong / kuari dan 3 atau lebih dari indikator tambahan	**INDIKATOR MANDATORI** ☐ Pelan/ Langkah-langkah pengurusan alam sekitar lombong / kuari **INDIKATOR TAMBAHAN** ☐ Sistem rawatan air berasid (jika berkenaan) ☐ Melakukan pensampelan air secara berkala (bulanan) ☐ Melakukan pensampelan air secara lebih kerap (harian/mingguan) ☐ Jadual penyelenggaraan kolam perangkap mendap/saliran ☐ *Detox system* ☐ Pemantauan air tanah menggunakan telaga pemantauan (*tubewell*) ☐ Penanaman pokok di sepanjang sempadan ☐ *Environmental response procedure* ☐ Sistem mencuci tayar (wheel wash) ☐ Lain-lain, nyatakan_____	
2.9	**Pelaksanaan amalan kerja mengikut Prosedur Operasi Standard (SOP)**			☐ Memenuhi indikator mandatori dan sekurang-kurangnya 2 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 4 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 6 indikator tambahan	**INDIKATOR MANDATORI** ☐ Mempunyai SOP **INDIKATOR TAMBAHAN** ☐ Mendapat akreditasi ☐ Mendapat anugerah ☐ SOP bagi pembuangan tanah beban ☐ SOP pengekstrakan ☐ SOP pemprosesan	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
							☐ SOP pengerudian ☐ SOP peletupan ☐ SOP penghancuran dan penskrinan ☐ SOP pengangkutan ☐ SOP pengendalian bahan berbahaya / toksik ☐ SOP pengurusan bahan hampas ☐ SOP lain-lain, nyatakan_____	
2.10	**Pengurusan aduan *(Complaints)*** *Nota: Jika tiada aduan dan dinyatakan secara berkala dalam buku rekod, markah penuh diberikan*			☐ Memenuhi indikator mandatori dan menyelesaikan dalam tempoh lebih 14 hari	☐ Memenuhi indikator mandatori dan menyelesaikan dalam tempoh 7 hingga 14 hari	☐ Memenuhi indikator mandatori dan menyelesaikan dalam tempoh kurang 7 hari	**INDIKATOR MANDATORI** ☐ Mengambil tindakan atas aduan ☐ Mempunyai Buku Rekod aduan ☐ Menyelenggara dan mengemaskini buku rekod aduan dengan baik ☐ Aduan yang diterima direkodkan/dilaporkan. ☐ Membuat pelaporan hasil siasatan aduan yang diterima /dilaporkan.	
2.11	**Rekod dan Pelaporan Kemalangan / Kemalangan nyaris (*Record of accidents / near miss*)** *Nota: Jika tiada kemalangan / kemalangan nyaris berlaku dan dinyatakan dalam buku rekod secara berkala, markah penuh diberikan.*			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan 3 indikator tambahan pertama	☐ Memenuhi indikator mandatori dan 3 indikator tambahan pertama dan mana-mana 2 indikator tambahan lain	**INDIKATOR MANDATORI** ☐ Mempunyai rekod kemalangan yang dikemaskini ☐ Melaporkan kemalangan maut dan kecederaan parah kepada JMG dengan segera secara bertulis ☐ Mengemukakan laporan ringkas ☐ Mengemukakan laporan penuh **INDIKATOR TAMBAHAN** ☐ Melaporkan kemalangan maut dan kecederaan parah kepada JMG dalam tempoh 24 jam ☐ Mengemukakan laporan ringkas dalam tempoh 3 hari ☐ Mengemukakan laporan penuh dalam tempoh 7 hari ☐ Kemalangan/ kemalangan nyaris yang berlaku/dilaporkan direkodkan. ☐ Menjalankan siasatan terhadap kemalangan/ kemalangan nyaris yang berlaku/dilaporkan. ☐ Membuat pelaporan hasil siasatan kemalangan/ kemalangan nyaris yang berlaku/dilaporkan. ☐ Membuat penambahbaikan hasil siasatan kemalangan/ kemalangan nyaris yang berlaku/dilaporkan. ☐ Lain-lain, nyatakan_____	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
2.12	Kemalangan yang berlaku termasuklah yang menyebabkan kerosakan hartabenda dan pencemaran alam sekitar. *Nota: sekiranya bilangan kemalangan melebihi* ≥5% bilangan pekerja, *tiada markah diberikan.*			☐ Memenuhi indikator mandatori dan bilangan kemalangan kecil kurang dari <5% daripada bilangan pekerja	☐ Memenuhi indikator mandatori dan bilangan kemalangan kecil kurang dari <3% daripada bilangan pekerja	☐ Memenuhi indikator mandatori dan direkodkan secara berkala	**INDIKATOR MANDATORI** ☐ Tiada kemalangan maut atau cedera parah untuk tempoh 12 bulan yang lepas ☐ Tiada kerosakan harta benda ☐ Tiada pencemaran alam sekitar	
	Jumlah Markah Bah. 2.0			_____%				
3.0	**FAEDAH *(BENEFITS)-*** *(kesan kepada kepentingan awam di sekeliling – ekonomi dan impak sosial)* **MARKAH: 15%**							
3.1	**Royalti *(Royalty)*** *Pembayaran royalti mengikut kadar dan masa yang ditetapkan (sebelum 7hb berikutnya)*			☐ Bayaran royalti <50% daripada jumlah perlu dibayar	☐ Bayaran royalti 50%<R< 80% daripada jumlah perlu dibayar	☐ Bayaran dibuat > 80% daripada jumlah perlu dibayar	☐ Nota: Jika tiada sebarang bayaran dibuat. Tiada markah diberikan.	
3.2	**Kearah Profesionalisma *(Towards professionalism)*** Mempunyai pengurus yang berkelayakan dan berdaftar dengan JMG*(Qualified manager & competent workforce)*			☐ Pengurus / Pen. Pengurus yang berdaftar	☐ Pengurus / Pen. Pengurus yang berdaftar dan berkelayakan (*mining, mechanical, mineral resources, mineral processing, metallurgist*) atau mana-mana orang yang mempunyai sijil yang diiktiraf JMG atau mempunyai pengalaman sekurang-kurangnya 8 tahun atau lebih dalam bidang berkenaan	☐ Pengurus / Pen. Pengurus yang berdaftar dan berkelayakan (*mining, mechanical, mineral resources, mineral processing, metallurgist*) atau mempunyai pengalaman sekurang-kurangnya 8 tahun atau lebih dalam bidang berkenaan dan menghadiri kursus-kursus meningkatkan kompetensi dalam tahun dinilai.	**INDIKATOR MANDATORI** ☐ Pengurus lombong / kuari yang berdaftar ☐ Penolong pengurus / penyelia yang berdaftar ☐ Pembedil (jika ada melakukan kerja peletupan)	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
3.3	**Tenaga mahir**			☐ Memenuhi sekurang-kurangnya 2 indikator	☐ Memenuhi sekurang-kurangnya 2- 4 indikator	☐ Memenuhi sekurang-kurangnya 5 indikator	**INDIKATOR** ☐ Jurutera Perlombongan / Sumber Mineral atau setara ☐ Ahli geologi ☐ Mekanik ☐ *Chargeman* ☐ Menghadiri kursus berkaitan ☐ Pengalaman dalam bidang ini ☐ Pengiktirafan profesional ☐ Pegawai Keselamatan dan Kesihatan Pekerjaan (jika bilangan pekerja melebihi 100 orang) ☐ Pegawai alam sekitar ☐ Juruteknik Makmal	
3.4	**Pembangunan Sumber Manusia *(Human Resource Development)***			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 1 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 3 indikator tambahan.	**INDIKATOR MANDATORI** ☐ Latihan ulangkaji 24 jam / pekerja untuk semua ☐ Kursus induksi kepada setiap pekerja baru ☐ Mempunyai buku log latihan pekerja ☐ Membuat caruman dalam *Human Resource Development Fund* (HRDF), Kementerian Sumber Manusia **INDIKATOR TAMBAHAN** ☐ Menghantar pekerja menghadiri kursus / persidangan yang diiktiraf HRDF (cth; IQM, CIDB, NIOSH dll) ☐ Kursus peralihan kepada pekerja yang akan bersara ☐ Mengiktiraf pekerja dengan sijil kehadiran kursus ☐ Menyediakan program dan peruntukan khas latihan dalaman (*in-house training*) ☐ Menghadiri kursus-kursus peningkatan diri yang lain seperti ceramah kerohanian dsb. ☐ Pelaksanaan gaji minimum (>RM900.00) ☐ Lain-lain, nyatakan_____	
3.5	**PenjanaanPekerjaan*(Employment generation)***			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 2 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 3 indikator tambahan.	**INDIKATOR MANDATORI** ☐ 30 % Pekerja tempatan daripada jumlah keseluruhan pekerja. ☐ Mempunyai permit kerja bagi pekerja asing **INDIKATOR TAMBAHAN** ☐ Lebih 30 % Pekerja tempatan ☐ 50% pekerja tempatan (profesional) ☐ 50% pekerja tempatan (pengurusan) ☐ 70% pekerja tempatan (Mahir dan separa mahir) ☐ 70% pekerja tempatan (Tidak mahir)	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
							☐ Program pemindahan pengetahuan dan kemahiran kepada pekerja tempatan. ☐ Lain-lain, nyatakan_____	
3.6	**Pembekal *(Supplier)*** Jumlah nilai bekalan daripada pembekal tempatan merangkumi mesin, jentera, alat ganti, bahan makan dan sebagainya			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 50%nilai bekalan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 50% nilai bekalan dan mempunyai polisi	**INDIKATOR MANDATORI** ☐ 30% daripada nilai bekalan dalam tahun semasa. **INDIKATOR TAMBAHAN** ☐ Polisi mengutamakan pembekal tempatan (dalam negara) ☐ Lain-lain, nyatakan_____ *Jika lebih kepada pembekal tempatan – diberi kelebihan markah. Penilaian dibuat pada tahun semasa.*	
3.7	**Pengiktirafan pekerja *(Employee recognition)***			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 1 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 2 indikator tambahan	**INDIKATOR MANDATORI** ☐ Mempunyai sistem pengiktirafan kepada pekerja (pekerja terbaik, pekerja contoh, pekerja setia) **INDIKATOR TAMBAHAN** ☐ Publisiti untuk pekerja yang diiktiraf ☐ Tempoh pengiktirafan pekerja secara berkala (bulanan, sukutahun dan tahunan) ☐ Pemberian insentif dalam bentuk bonus dan kenaikan gaji ☐ Penghargaan dalam bentuk hadiah, lawatan dan percutian ☐ Lain-lain insentif, nyatakan;_____	
	Jumlah Markah Bah. 3.0			_____%				
4.0	**AMALAN *HIJAU (GREEN PRACTICES)* -** Kelangsungan industri untuk bergerak lebih jauh/maju pada masa hadapan. **MARKAH: 5%**							
4.1	**Bio-Diversity**							
	▪ Penanaman dan pengekalan pokok bagi pembiakan flora ▪ *Animal sanctuary* (Rusa, Kelulut, Burung, ikan, etc)			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 2 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 4 indikator tambahan	**INDIKATOR MANDATORI** ☐ Pembukaan kawasan secara terpilih ☐ Program (Nyatakan;_____/ pelan penanaman / pembiakan semula flora / fauna **INDIKATOR TAMBAHAN** ☐ Menjalankan survei inventori ke atas spesis flora dan fauna sebelum pembukaan kawasan ☐ Tanah atas (*top soil*) disimpan ditempat tertentu	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
							☐ Tanah beban (*overburden*) dilonggok di kawasan yang ditetapkan ☐ Penyediaan kemudahan (nurseri, kolam, sarang) untuk flora/fauna membiak dan hidup ☐ Penyelenggaraan secara berkala supaya flora/fauna mampu membiak dan hidup sendiri ☐ Mempunyai peruntukan khas ☐ Mempunyai kakitangan yang bertanggungjawab mengendalikan flora/fauna ☐ Lain-lain, nyatakan_____	
4.2	**Pemulihan(*Rehabilitation)***							
	○ Inisiatif menjalankan pemulihan ***Nota:*** *Lombong baru:* *skala besar – selepas 3 tahun [rujuk Sek. 64(2) EMN], Skala kecil – selepas setahun.* *Tiada skala bagi kuari*	Sek.64 EMN		☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 2 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 3 indikator tambahan	**INDIKATOR MANDATORI** ☐ Melaksanakan kerja pemulihan **INDIKATOR TAMBAHAN** ☐ Mempunyai pelan pemulihan (termasuk penutupan) dan melaksanakannya ☐ Pemulihan progresif secara berterusan ☐ Menyediakan Laporan Kemajuan Pemulihan ☐ Mempunyai unit / individu yang bertanggungjawab ☐ Mempunyai dana/peruntukan pemulihan ☐ Mencarum dalam tabung pemulihan ☐ Lain-lain, nyatakan_____ ☐	
4.3	• Inovasi dan teknologi *(Innovation and technologies)*			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 2 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 3 indikator tambahan	**INDIKATOR MANDATORI** ☐ Penggunaan teknologi/inovasi hijau berkaitan dengan industri **INDIKATOR TAMBAHAN** ☐ Teknologi yang ditambahbaik ☐ Teknologi dari inovasi sendiri ☐ Mendapat anugerah atau pengiktirafan (Pensijilan ISO) ☐ Mempunyai atau menggunakan lebih dari satu teknologi hijau ☐ Mempunyai kepakaran dalam mengaplikasikan teknologi ☐ Mempunyai dasar penggunaan teknologi/inovasi hijau ☐ Lain-lain, nyatakan_____	
4.4	• Program Kitar Semula *3R (Reuse, Reduce, Recycle)*			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-	☐ Memenuhi indikator mandatori dan sekurang-	**INDIKATOR MANDATORI** ☐ Melaksanakan aktiviti 3R **INDIKATOR TAMBAHAN**	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
					kurangnya 2 indikator tambahan	kurangnya 3 indikator tambahan	☐ Mempunyai Dasar 3R ☐ Program Kempen Kesedaran dijalan secara berkala ☐ Mempromosi kitar semula dalam kawasan operasi ☐ Menerima anugerah atau pengiktirafan 3R ☐ Menyediakan tong kitaran semula ☐ Memanfaatkan semula sisa industri untuk kegunaan sendiri atau pihak lain (contoh tayar untuk tukun dan *conveyor belt* sebagai *blasting mat*). ☐ Lain-lain, nyatakan_____	
4.5	• Kecekapan Tenaga *(Energy efficiency)*			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan 2 indikator tambahan	☐ Memenuhi indikator mandatori dan 3 indikator tambahan	**INDIKATOR MANDATORI** ☐ Penggunaan Jentera baru / teknologi baru (berusia kurang dari 5 tahun) **INDIKATOR TAMBAHAN** ☐ Mempunyai pensijilan *(certification)* ☐ Menggunakan teknologi hijau ☐ Tenaga diperbaharui ☐ Lain-lain (Nyatakan _____)	
	Jumlah Markah Bah. 4.0			_____%				
5.0	**TANGGUNGJAWAB SOSIAL DAN KORPORAT *(CORPORATE AND SOCIAL RESPONSIBILITY)*** **MARKAH: 10%**							
5.1	**Kemudahan asas kepada pekerja *(Facilities for workers)*** *Menyediakan tandas, kantin, asrama/kuaters, hiburan, sukan*			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan 2 indikator tambahan	☐ Memenuhi indikator mandatori dan 3 atau lebih indikator tambahan	**INDIKATOR MANDATORI** ☐ Kemudahan sanitari yang mencukupi ☐ Mempunyai ruang makan ☐ Menyediakan peti ubat kecemasan *(First aid kit)* **INDIKATOR TAMBAHAN** ☐ Tempat dan peralatan sukan/riadah disediakan ☐ Makan percuma disediakan/disubsidi ☐ Rumah tamu/ruang khas tetamu/pelawat ☐ Kemudahan komunikasi dan maklumat – internet, telefon awam, surat khabar, majalah ☐ Kemudahan kesihatan – pegawai/pembantu perubatan atau panel perubatan luar ☐ Tempat tinggal/kuarters disediakan berasingan bagi lelaki dan perempuan ☐ Lain-lain, nyatakan_____	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
5.2	**Program Pembelajaran Komuniti** ***(Community Learning programme)*** *Menyediakan latihan kemahiran kepada pelajar dan komuniti setempat*			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan 2 indikator tambahan	☐ Memenuhi indikator mandatori dan 3 atau lebih indikator tambahan	**INDIKATOR MANDATORI** ☐ Mempunyai program latihan **INDIKATOR TAMBAHAN** ☐ Memberikan elaun kepada pelajar ☐ Menerima lawatan pihak luar (pelajar, masyarakat) ☐ Menganjurkan ceramah terbuka/ ceramah kesedaran kepada pekerja/ masyarakat ☐ Menyediakan skim perantis ☐ Menyediakan pusat latihan khas ☐ Lain-lain, nyatakan_____	
5.3	• Program Bersama Masyarakat *(Public Relation Programs)*Gotong-royong jamuan, hari terbuka dan sebagainya.			☐ Memenuhi Sekurang-kurangnya 2 indikator	☐ Memenuhi Sekurang-kurangnya 2- 4 indikator	☐ Memenuhi Sekurang-kurangnya 5 indikator	**INDIKATOR** ☐ Mengadakan program kemasyarakatan ☐ Penganjuran hari terbuka ☐ Penyertaan dalam pameran/ ekspo etc ☐ Penganjuran gotong-royong ☐ Penyertaan dalam gotong royong ☐ Penyertaan dalam majlis setempat ☐ Penganjuran termuduga terbuka untuk pengambilan pekerja ☐ Penggunaan tenaga kerja tempatan ☐ Penglibatan pembekal setempat/ penggunaan kontraktor tempatan ☐ Perkongsian maklumat – ekonomi, alam sekitar, kelestarian, dan lain-lain ☐ Lain-lain, nyatakan_____	
5.4	• Sumbangan Setempat *(Contribution to local community)* *Masjid, persatuan, jalan dsb. sila nyatakan jika ada tambahan*			☐ Memenuhi Sekurang-kurangnya 2 indikator	☐ Memenuhi Sekurang-kurangnya 2- 4 indikator	☐ Memenuhi Sekurang-kurangnya 5 indikator	**INDIKATOR** ☐ Derma ☐ "Gantirugi" – contoh: gangguan kepada kawasan perayauan orang asli ☐ Tajaan sukan, perubatan, biasiswa – berkala/ tahunan/ bulanan ☐ Komitmen sumbangan berkala – contoh: pembaikian jalan ☐ Penyediaan tabung bantuan kepada masyarakat setempat ☐ Tajaan aktiviti secara *one-off* ☐ Sumbangan tenaga/peralatan – bantuan bencana, kerja-kerja pemulihan/ pembaikan jalan, bangunan ☐ Penyediaan bekalan air ☐ Penyediaan bekalan tenaga ☐ Pembinaan jalan	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
							☐ Pembinaan masjid/surau/rumah ibadat ☐ Memberi bantuan kepada masyarakat setempat melalui latihan kemahiran dan kewangan ☐ Lain-lain, nyatakan_____	
5.5	• Program Anak Angkat *(adoption for care)* *Sekolah, jalanraya, dewan dan sebagainya.*			☐ Memenuhi Sekurang-kurangnya 1 indikator	☐ Memenuhi Sekurang-kurangnya 2 indikator	☐ Memenuhi Sekurang-kurangnya 3 indikator	**INDIKATOR** ☐ Sekolah angkat ☐ Komitmen sumbangan berkala – contoh: pembaikan jalan ☐ Rumah anak yatim ☐ Rumah orang tua ☐ Wad/ hospital ☐ Taman haiwan (zoo) ☐ Lain-lain, nyatakan_____	
5.6	• Penglibatan jawatankuasa bersama *(Joint local committee)*			☐ Memenuhi Sekurang-kurangnya 1 indikator	☐ Memenuhi Sekurang-kurangnya 2 indikator	☐ Memenuhi Sekurang-kurangnya 3 indikator	**INDIKATOR** ☐ Dialog antara pengusaha/penduduk ☐ Mesyuarat tetap jawatankuasa pengusaha/penduduk setempat ☐ Keahlian dalam mana-mana jawatankuasa setempat ☐ Keahlian dalam mana-mana jawatankuasa/pertubuhan/persatuan ☐ Lain-lain, nyatakan_____	
	Jumlah Markah Bah. 5.0			_____%				
6.0	**ESTETIKA *(AESTHETIC)-*** *Aesthetic values to improve the public acceptance* **MARKAH:5%**							
6.1	**Penampilan *(Appearance/Visual)***			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sebahagian kawasan kerja masih boleh dilihat dari pandangan awam	☐ Memenuhi indikator mandatori dan keseluruhan kawasan kerja terlindung dari pandangan awam dan memenuhi semua indikator tambahan.	**INDIKATOR MANDATORI** ☐ Zon penghijauan / penghadang pandangan (pokok ditinggalkan atau ditanam semula atau *hoarding*untuk melindungi pandangan negatif orang awam) **INDIKATOR TAMBAHAN** ☐ Mempunyai zon penghijauan yang mencukupi berdasarkan peratus ditetapkan (tanam pokok, netting dll) ☐ Penghijauan muka lombong/kuari yang tidak aktif dari pandangan awam ☐ Lain-lain, nyatakan_____	
6.2	**Lanskap (Landscape)**			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-	**INDIKATOR MANDATORI** ☐ Program lanskap dijalankan	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
					dan mana-mana 3 indikator tambahan	kurangnya 4 indikator tambahan.	☐ Mempunyai *person in-charge* (membudayakan pengindahan sebagai satu keperluan) **INDIKATOR TAMBAHAN** ☐ Menanam kepelbagaian spesis tumbuhan yang menarik sesuai dengan persekitaran. ☐ Penyelenggaraan landskap dibuat secara berkala ☐ Mempunyai nurseri sendiri ☐ Mengadakan program penghijauan ☐ Mempunyai peruntukan khas untuk program lanskap ☐ Mempunyai kawasan khusus lanskap cth sekitar pejabat, view point, kantin, tempat rekreasi, pintu utama ke lombong/kuari ☐ Mengadakan kolam air pancut, kolam ikan, ternakan binatang peliharaan, jeti, gazebo dan sebagainya ☐ Lain-lain, nyatakan_____	
6.3	**Kekemasan*(housekeeping)***							
	i. Bengkel (Workshop)			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan mana-mana 1 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 3indikator tambahan.	**INDIKATOR MANDATORI** ☐ Kemas dan bersih (tidak kotor) ☐ Mempunyai tempat khusus, ☐ Sistem kawalan kebocoran / tumpahan minyak (lantai konkrit, perparitan, kolam perangkap minyak dan sebagainya ☐ Alat pemadam api berfungsi dengan baik ☐ Pelupusan sisa minyak **INDIKATOR TAMBAHAN** ☐ *Tagging*perkasasan ☐ Kemudahan kepada pekerja (tandas, *locker*, bilik persalinan/rehat) ☐ Tong sampah kitar semula ☐ Penyimpanan barangan yang teratur ☐ Sistem pelupusan sampah domestik ☐ Lain-lain, nyatakan_____	
	ii. Pejabat			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 3 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 5indikator tambahan.	**INDIKATOR MANDATORI** ☐ Mempunyai tempat khusus ☐ Kemas dan bersih – luar dan dalam ☐ Susun atur yang sistematik ☐ Penyimpanan fail yang teratur (mempunyai kabinet fail) **INDIKATOR TAMBAHAN**	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
							☐ Tagging / papan tanda pejabat ☐ Tandas ☐ Pantri ☐ Surau ☐ Ruang menunggu ☐ Bilik mesyuarat ☐ Ergonomik (kesesuaian ruang kerja termasuk kelengkapan pejabat) ☐ Sistem pencahayaan dan pengudaraan ☐ Lain-lain, nyatakan_____	
	iii. Kantin (Jika ada)			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 3 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 5indikator tambahan.	**INDIKATOR MANDATORI** ☐ Mempunyai tempat khusus dan tidak terdedah kepada habuk dan pencerobohan binatang ☐ Kemas dan bersih – luar dan dalam ☐ Menyediakan makanan bersih dan suci ☐ Tempat mencuci dan sabun basuh tangan **INDIKATOR TAMBAHAN** ☐ Tempat pembuangan sisa makanan ☐ Tagging / papan tanda kantin ☐ Sistem pencahayaan dan pengudaraan ☐ Bertutup ☐ Susun atur meja makan yang sistematik ☐ Memasang alat pencegah serangga ☐ Menyediakan kipas angin atau pendingin hawa ☐ Lain-lain, nyatakan_____	
	iv. Kuarters / rumah kongsi (jika ada)			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 3 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 6 indikator tambahan.	**INDIKATOR MANDATORI** ☐ Mempunyai tempat khas ☐ Kemudahan air bersih ☐ Bekalan elektrik ☐ Menyediakan kelengkapan tidur yang sesuai dan selesa ☐ Kemas dan bersih – luar dan dalam ☐ Susun atur yang baik ☐ kemudahan tandas / bilik **INDIKATOR TAMBAHAN** ☐ Tagging / papan tanda kuaters ☐ Bilangan tandas dan bilik mandi bersesuaian mengikut nisbah pekerja (tambahan) ☐ Ruang membasuh pakaian dan tempat sidaian yang bersesuai ☐ Surau / tempat bersolat	

Bil	KRITERIA	SUMBER	Ada / Tiada	1	2	3	KETERANGAN	CATATAN (jika ada)
							☐ Sistem pencahayaan dan pengudaraan ☐ Tempat memasak ☐ Kemudahan sukan dan rekreasi ☐ Kemudahan tandas/ bilik air untuk berlainan jantina ☐ Penyediaan kemudahan komunikasi ☐ Lain-lain, nyatakan_____	
6.4	**Jalan masuk ke lombong/kuari** Nota: - Sekiranya jalan masuk dalam kawalan kuari/lombong sahaja, jalan masuk dikira daripada jalanraya utama ke pintu masuk kuari			☐ Memenuhi indikator mandatori	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 2 indikator tambahan	☐ Memenuhi indikator mandatori dan sekurang-kurangnya 4 indikator tambahan.	**INDIKATOR MANDATORI** ☐ Berturap sekurang-kurangnya dengan agregat ☐ Diselenggara dengan baik ☐ sistem perparitan yang mencukupi **INDIKATOR TAMBAHAN** ☐ Mempunyai papan tanda indikator arah lombong/kuari ☐ Mempunyai tanda lalulintas seperti had laju, arah laluan dan lain-lain ☐ Mempunyai pondok pengawal / palang di jalan masuk ☐ menyediakan washing bay / water sprayer ☐ Lebar jalan bersesuaian (boleh dilalui secara 2 hala) ☐ Berturap dengan tar/konkrit ☐ Lain-lain, nyatakan_____	
	Jumlah Markah Bah. 6.0			_____%				

PEMARKAHAN

Markah Bah. 1.0	%
Markah Bah. 2.0	%
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Markah Bah. 5.0	%
Markah Bah. 6.0	%

JUMLAH MARKAH KESELURUHAN	%

Appendix 7-2

SDI ON MINING AND PROCESSING OF REE

SDI ON MINING AND PROCESSING OF REE

APPENDIX 7-2

1.0 INTRODUCTION

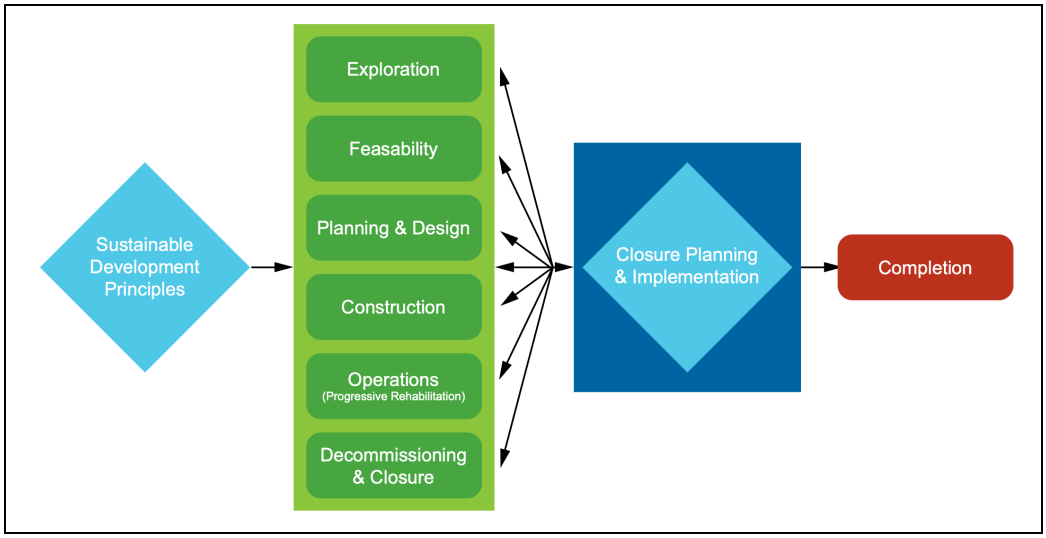
The Brundtland Commission, in its landmark report Our Common Future, defined sustainable development as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Sustainable development includes at least economic, social, and environmental dimensions. The mining and minerals industry face some of the most difficult sustainability challenges of any industrial sector. A commitment to leading practice sustainable development is critical for a mining industry to gain and maintain its 'social licence to operate' in the community. To secure its continued 'social licence' to operate, the industry must respond to these challenges by engaging its many different stakeholders and addressing their sustainability concerns. The industry must also be able to measure and assess its sustainability performance and to demonstrate continuous improvements over long term.

The sustainable development in mining integrates environmental, economic and social aspects through all phases of mineral production from exploration through construction, operation and mine-site closure as shown in **Figure 1**. The concept of leading practice is about identifying and implementing the best way of doing things for a given site. As new challenges emerge and new solutions are developed, or better solutions are devised for existing issues, it is important that leading practice be flexible and innovative in developing solutions that match site-specific requirements. Although there are underpinning principles, leading practice is as much about approach and attitude as it is about a fixed set of practices or a particular technology.

2.0 SUSTAINABLE MINING

Mining and processing of mineral generally disturb the ecology ecosystem and community where the minerals are located. The activities create pressure which impacted the well-being of the environment. The community responds hard should the impacts are seen exceeding their perceived limits. The respond by the industry is normally in the form of abatement initiatives as attempts to release the pressure or to conserve the affected natural resource. **Figure 2** depicts a base model in understanding and implementing an evaluation system on mineral resource utilization and conservation within a local

ecosystem. Human and community well-beings are greatly rely on the ecosystem health which provide raw materials from the natural resources for their consumption. Thus, a sustainability evaluation system for the REE resource development is important in balancing between the ecosystem health and the community needs are met. The elements within the framework as shown in **Figure 3** provides general guideline in establishing focus area, the impact to the ecosystem by the REE resource development.



Source: Laurence (2011)

Figure 1: The Underlying Sustainable Development Principles of a Mining Project

NRC (1997) focused on the following aspects in defining sustainable development in mineral and mining, that are (1) exploration, (2) extraction, (3) production, (4) value add, dan (5) utilization; with emphasis on efficiency, competitiveness, dan responsibility towards the environment. British Government (1996) also outlined list of approaches with respect to sustainable mining. Among the suggestions are (1) to balance between resource sustainability and the economic needs, (2) to minimize negative impacts of the mining operation on the environment, (3) due care approach in the working practices, (4) rehabilitation and area maintenance, and (5) prevention of resource sterilization due to incompatible land use or other activity. Based on the said definition of mining sustainability, a relationship framework between mining activities and ecology system as shown in **Figure 4** may be established. The framework depicts the relationship based on industry respond system towards environmental, economy and community. As shown in **Figure 4**, the REE resource development involves the implementation of various phases of activities which comprise of exploration, extraction, processing and utilization. Each element which has its own scope of activities shall be guided towards sustainability in their undertaking as summarized in **Figure 5**.

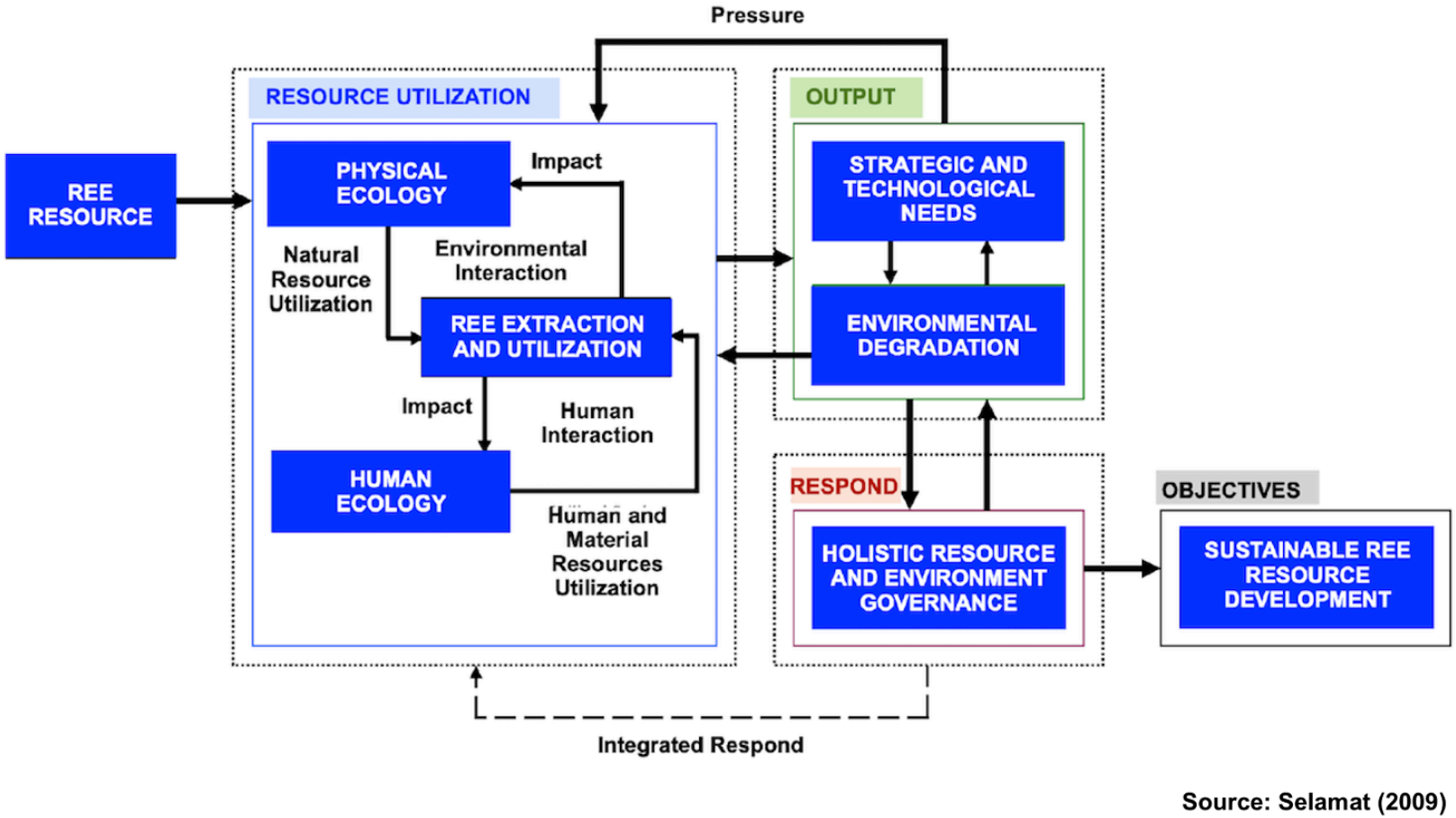


Figure 2: The Industry Respond System Towards Sustainable REE Mining and Processing

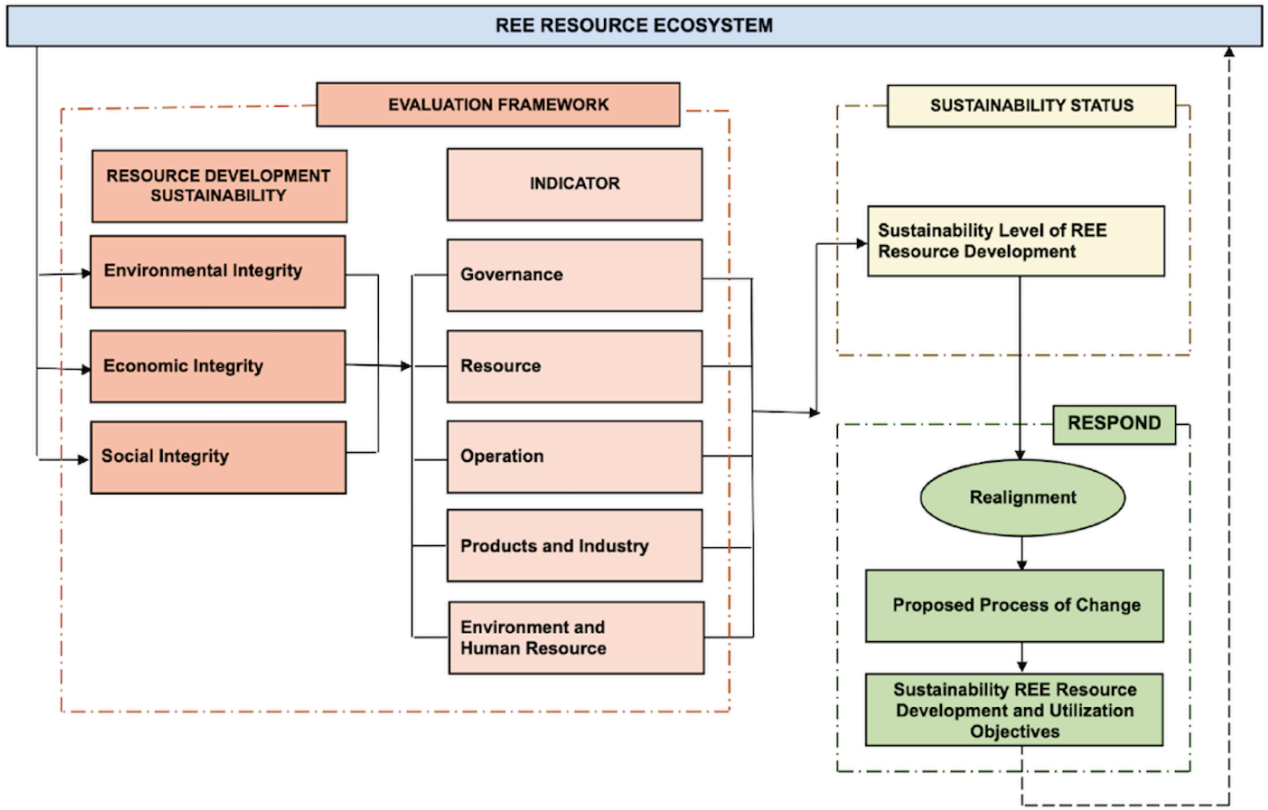


Figure 3: Sustainability Framework for the REE Resource Development

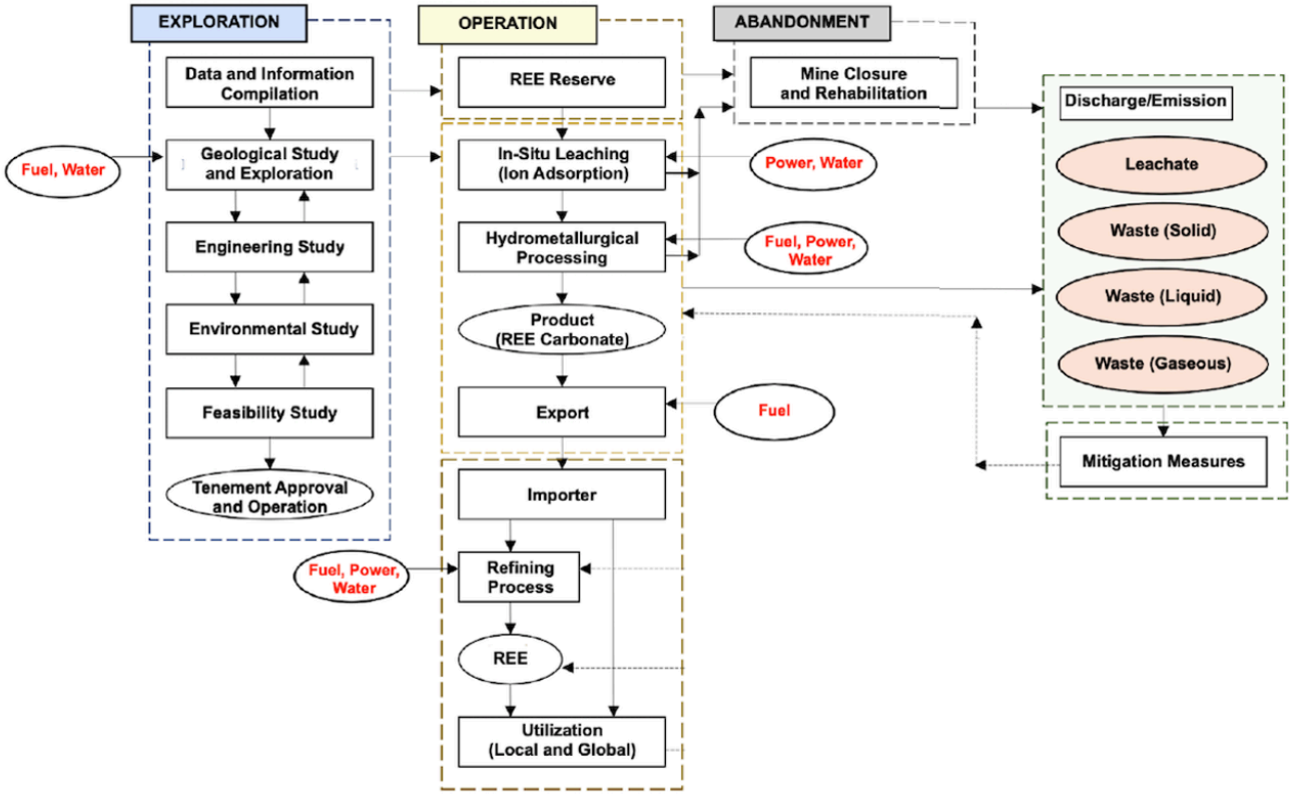


Figure 4: Overall REE Mining and Processing Phases

Source: Laurence (2018)

Figure 5: Components of Sustainability in Mining

3.0 NATIONAL MINERAL POLICY

On the policy level, the National Mineral Policy NMP2 would be a useful tool to further elevate Malaysia's mineral potential towards effective sustainability. Security of tenure and practical approved mining lease period are 2 critical issues for effective, economically recover payback back on investments into the project. The major concern of mineral development operations is the security of site tenure. This efficient NMP2 includes significant features that cover critical aspects such as the security of tenure, favourable fiscal systems, high priority land use for mineral resource projects, a uniform institutional framework with transparent guidelines and regulations.

The National Mineral Policy 2 (NMP2) has been formulated to provide the foundation for the development of an effective, efficient and competitive regulatory environment and an attractive investment climate for the mineral sector. The strategic directions of the policy are to expand and diversify the mineral sector through optimum exploration, and utilization of resources though modern technology and sustainable development. The noble objectives of NMP2 aimed towards economic sustainability of the mineral resource sector are as follows:

- ✧ To ensure the systematic sustainable development and optimal utilisation of the nation's available precious mineral resources;
- ✧ To promote efficient stewardship by ensuring that the nation's mineral resources are developed in an environmentally-friendly and responsible manner;
- ✧ To enhance the economic competitiveness and progress of the nation's mineral sector at the international level;
- ✧ To encourage the optimum use of locally produced minerals and also to promote the further growth of any potential mineral-based product industry; and

- ✧ To further promote the recovery, recycling and reuse of metals and minerals already used in the construction and industrial sectors for further development.

4.0 SUSTAINABLE DEVELOPMENT GOALS

In 2015, the United Nation (UN) launched 17 Sustainable Development Goals (SDG) as part of an Agenda to be achieved by 2030. The target is having a global plan of action, aiming at universal peace and social and environmental justice. For this, 169 goals were drawn. The objective of this research is to discuss the congruence between mining activity and the SDG, starting from experiences of the scientific literature and the observation of one mining activity.

Six Sustainable Goals (SGD) relevance to mining in particular the REE mining operation are as follows:

- ✧ **SDG 1: Poverty Eradication**
  Mining generates significant revenue streams through taxes, royalties and dividends for governments to invest in socioeconomic development.

- ✧ **SDG 6: Clean Water and Sanitation**
  Ensure effective management of water and sanitation through continuous monitoring. Water quality monitoring near and at the upstream of the mine with sharing of the water quality with the local community.

- ✧ **SDG 7: Affordable and Clean Energy**
  Mining activities are also energy and emissions intensive in terms of the production and downstream uses of mining products.

- ✧ **SDG 8: Decent Work and Economic Growt**h
  Mining can alter the lives of local communities, offering opportunities for jobs and training, while contributing to economic and social inequities if not appropriately managed.

- ✧ **SDG 9: Industry, Innovation, and Infrastructure**
  Mining can help drive economic development and diversification through direct and indirect economic benefits, the development of new technologies and by spurring the construction of new infrastructure for transport, communications, water and energy.

- ✧ **SDG 12: Responsible Consumption and Production**
  Ensure sustainable consumption and production through minimum effluent discharge and other pollution with participant of the local community.

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