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ATTACHMENTS

LIST OF ABBREVIATIONS

AMD	:	Acid Mine Drainage (aka Acid Rock Drainage)
AMSL	:	Above Mean Sea Level
BOD	:	Biochemical Oxygen Demand
COD	:	Chemical Oxygen Demand
CSP	:	Crushing & Screening Plant
CSR	:	Corporate Social Responsibilities
DO	:	Dissolved Oxygen
EIA	:	Environmental Impact Assessment
ESCP	:	Erosion & Sediment Control Plan
FR	:	Forest Reserve
gm	:	gram
ha	:	hectare
JAS	:	Jabatan Alam Sekitar
JKKP	:	Jabatan Keselamatan & Kesihatan Pekerjaan
JMG	:	Jabatan Mineral & Geosains
JPAS	:	Jabatan Perlindungan Alam Sekitar
JPBW	:	Jabatan Perancang Bandar & Wilayah
JPS	:	Jabatan Pengairan & Saliran
JTU	:	Jabatan Tanah & Ukur
JUPEM	:	Jabatan Ukur & Pemetaan Malaysia
km	:	kilometre
km^2	:	square kilometre
μm	:	micron
MAAQG	:	Malaysian Ambient Air Quality Guidelines (JAS)
MNRE	:	Ministry of Natural Resources & Environment
mt	:	metric tonne
MOH	:	Ministry of Health
MSDS	:	Material & Safety Data Sheet
MSMA	:	Manual Saliran Mesra Alam
NE	:	Northeast
NH_3-N	:	Ammoniacal nitrogen
NWQSM	:	National Water Quality Standards for Malaysia (JAS)
O&G	:	Oil & Grease
OPP	:	Ore Processing Plant
OSY	:	Ore Storage Yard
OTP	:	Ore Treatment Plant
OWP	:	Ore Washing Plant
PL	:	Prospecting Licence
PPE	:	Personal Protection Equipment
PPV	:	Peak Particle Velocity
QRP	:	Qualified Registered Professional
RIL	:	Reduced Impact Logging
ROM	:	Run-Of-Mine

LIST OF ABBREVIATIONS (cont)

SAPS	:	Successive Alkalinity Producing System
SEX	:	Sodium Ethyl Xanthate
SFD	:	Sabah Forestry Department
SHE	:	Safety, Health & Environment
SO_4	:	Sulphate
SOP	:	Standard Operating Procedures
SWD	:	Sabah Wildlife Department
SWR	:	Scheduled Waste Regulation
TAS	:	Tactical Air Sampler
TDS	:	Total Dissolved Solids
TSF	:	Tailings Storage Facilities
TSP	:	Total Suspended Particulates
TSS	:	Total Suspended Solids
WQI	:	Water Quality Index (JAS)
WWF-MY	:	World Wildlife Organization (Malaysia)

1 INTRODUCTION

1.1 Project Title

The title of this project is:

ENVIRONMENTAL IMPACT ASSESSMENT (SPECIAL) FOR THE PROPOSED GOLD MINING AT MOUNT WULLERSDORF, TAWAU, SABAH

This is a gold mining project, and shall be hereinafter referred to as "the Project".

1.2 Project Initiator

Name	:	**Southsea Gold Sdn Bhd**
Address	:	Lot 4, Block E, Bandar Nam Tung, Jalan Leila P O Box 2112, 90724 Sandakan, Sabah
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1.3 EIA Consultants

Name	:	**GMC Environmental Sdn Bhd** (**No: F005/ Exp: 30.09.2015**)
Address	:	Lot 41, 3rd Floor, Block F Damai Plaza Phase IV 88300 Kota Kinabalu, Sabah
Contact number	:	088-233 821 088-231 820 (fax) gmc_environmental@live.com
Contact person	:	**Tan Han Meng**

1.4 Statement of Needs

The Project proposes to:

- expand mineral-based resource development in Sabah feasibly through developing the site into a workable mine
- generate alternative resource revenue to the Sabah Government
- enhance local socio-economic development through long-term chain employment with related contracting activities and CSR contributions

2 BACKGROUND INFORMATION

2.1 Project Location

The site (**Figure A1**) covers a parcel of land about 948 ha (**Table 2.1**) in the Mt Wullersdorf area, about 30 km northwest and 17½ km north of Tawau town and Tawau Airport respectively, and is currently readily accessible via estate feeder roads off Jalan Bukit Bald – Bukit Mull –Bukit Kawa that is linked essentially to the main road (Jalan Tawau – Lahad Datu) at Balung.

Table 2.1: Site boundary coordinates (approx, **Figure A2**)

Point	Latitude (N)	Longitude (E)
A	04°30'50.0"	118°06'17.0"
B	04°30'49.1"	118°07'44.0"
C	04°30'31.3"	118°07'52.2"
D	04°30'28.0"	118°07'40.6"
E	04°30'14.7"	118°07'37.7"
F	04°30'14.7"	118°07'52.0"
G	04°28'36.2"	118°07'51.2"
H	04°28'36.6"	118°06'53.7"
I	04°29'31.3"	118°06'54.1"
J	04°29'31.5"	118°06'16.3"

P 2.2a: Typical view of the access road through Mt Wullersdorf FR to the site.
21.08.2014

P 2.2b: The graveled estate feeder road leading to the site from Jalan Bukit Bald.
21.08.2014

P 2.2c: Jalan Bukit Bald.
21.08.2014

P 2.2d: Jalan Bukit Mull.
21.08.2014

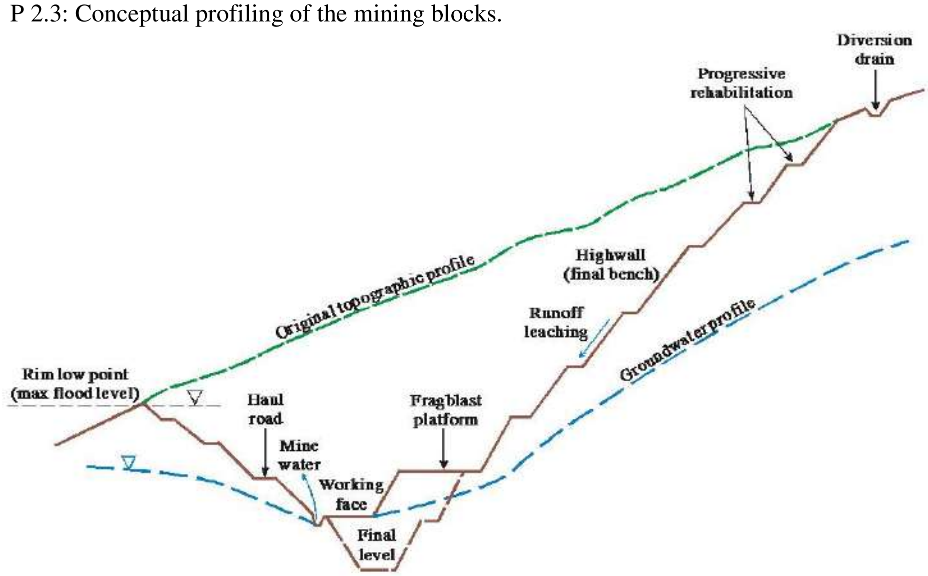
P 2.2e: Jalan Bukit Kawa.

21.08.2014

2.2 Project Concept

The Project proposes surface mining at 2 predetermined mining blocks (**Figure A2**) at the Bukit Mantri and Bukit Tundong areas (hereinafter referred to as Mantri Block and Tundung Block respectively) for the surface (oxidized) and the underlying sulfide (un-oxidized) ores by excavations using only hydraulic excavators, but necessarily engaging also fragblasts (rock fragmentation by blasting) for the latter.

P 2.3: Conceptual profiling of the mining blocks.



The overburden and intraburden materials will be disposed on-site at the waste dumps while the ROM (source materials) further physically processed on-site at the OWP, CSP and OTP for sizing (crushing), screening (segregation), washing and grinding (pulverization) then separation (centrifugal and flotation) of the ore minerals prior to shipping out the ore concentrates from the sea port nearest to the site, with the slurry discharge retained in the TSF.

2.3 Environmental Compliance

The Project will observe the following environmental requirement to effect the mining operations.

- A mandatory EIA approval from JPAS under Prescribed Activity 7 of the Second Schedule of the Environment Protection (Prescribed Activities) (Environment Assessment Impact) Order 2005, Environment Protection Enactment 2002, for ***Mining including open cast mining for minerals pursuant to any mining lease:***

  (i) Covering an area of 20 ha or more
  (ii) Any form of mining which is likely to affect the landscape of the mining area so as to require rehabilitation thereof upon the cessation of the mining activities, or which involves the use of chemicals or explosives.

2.4 Project Status

A 4-year prospecting (**Annex B1**) covering an area about 200 km^2 (ie 20,000 ha) has delineated economical ore reserves (**Section 3.1.4**) at the Mantri and Tundung areas, and the Mining Lease (**Annex B2**) was also recently granted for the Project subject notwithstanding to the Project meeting the statutory requirements (**Table 2.2**) under the prevailing laws.

Table 2.2: Statutory compliance status of the Project

Requirement	Compliance status	Auditing/ approving authority	Clearance status
Mining Lease	Completed	JTU	Cleared
Land title demarcation[1]	Completed	JTU	Pending
Mining scheme	Completed	JMG	Cleared[2]
EIA	In progress	JPAS	Pending
ESCP	Pending	JPS	Pending

1: **Annex B3**
2: **Annex B4**

2.5 Land Status

The site covers an area recently excised that which otherwise comprising about 720 ha and 228 ha of Mt Wullersdorf and Ulu Kalumpang FR respectively, and shall be subject to such other prior clearance from the relevant authorities for the mining.

2.6 Project Activities

These activities are categorized in the following general procedural order of implementation.

- Site investigations
- Site preparation and development
- Operations
- Cessation

2.6.1 Site Investigations

Investigations shall primarily include geological, mining engineering, erosion and sediment control, and EIA. Current geological assessment by way of mineral exploration during the Prospecting Licence period has indicated ore mineralization while engineering assessment through the proposed mining scheme also suggested possible mining subject to meeting the environmental requirements.

2.6.2 Site Preparation & Development

Site preparation and development will require mobilizing the mine equipment and machinery necessary for land clearance by stripping the surface vegetation and levelling to establishing the mine structures (**Table 2.3**) such as the OWP, CSP, OTP and the internal infrastructures such as the haul road to the mining blocks and waste tips. The OWP installation may require about 3 months while the CSP and OTP about 9 months.

Essentially, the development phase will be implemented over several stages, with the initial stage anticipated completion in about 4 months prior to commencing the mining operations thereafter concurrently with the subsequent stages.

The Project has proposed to begin the mining at ES-1 where the surface area will be progressively cleared of vegetation and the earth waste materials tipped at the neighbouring waste dumps along with the dry muckpiles from the processing plant. Hence, the initial stage of development will include but not necessarily limit to following installations and preparations.

- Mine quarters and workshop
- Haul roads to Mantri Block and waste dumps (WD-1 and WD-2)
- TSF (tailings storage facilities)
- OSY (ore storage yard)
- OWP (ore washing plant)

Table 2.3: Proposed primary mine equipment and machinery

No	Equipment/ machinery	Oxidized ore	Sulfide ore
1	Hydraulic excavator	6	
2	Bulldozer	1 – 2	
3	Dump truck	10	
4	Backhoe tractor	1	-
5	Hydraulic driller	-	2
6	OWP	1	-
7	Hopper feeder	-	1
8	CSP	-	1
9	Scrubber	1	
10	Ball mill	2 – 4	
11	Screener	2 – 4	
12	Shaking table	2	-
13	Flotation cell	-	4 – 8
14	Centrifugal concentrator	1	-
15	Classifier	-	1
16	Water pump	2	
17	Power generator	1	1

NB: OTP consisting of items (9) – (15)

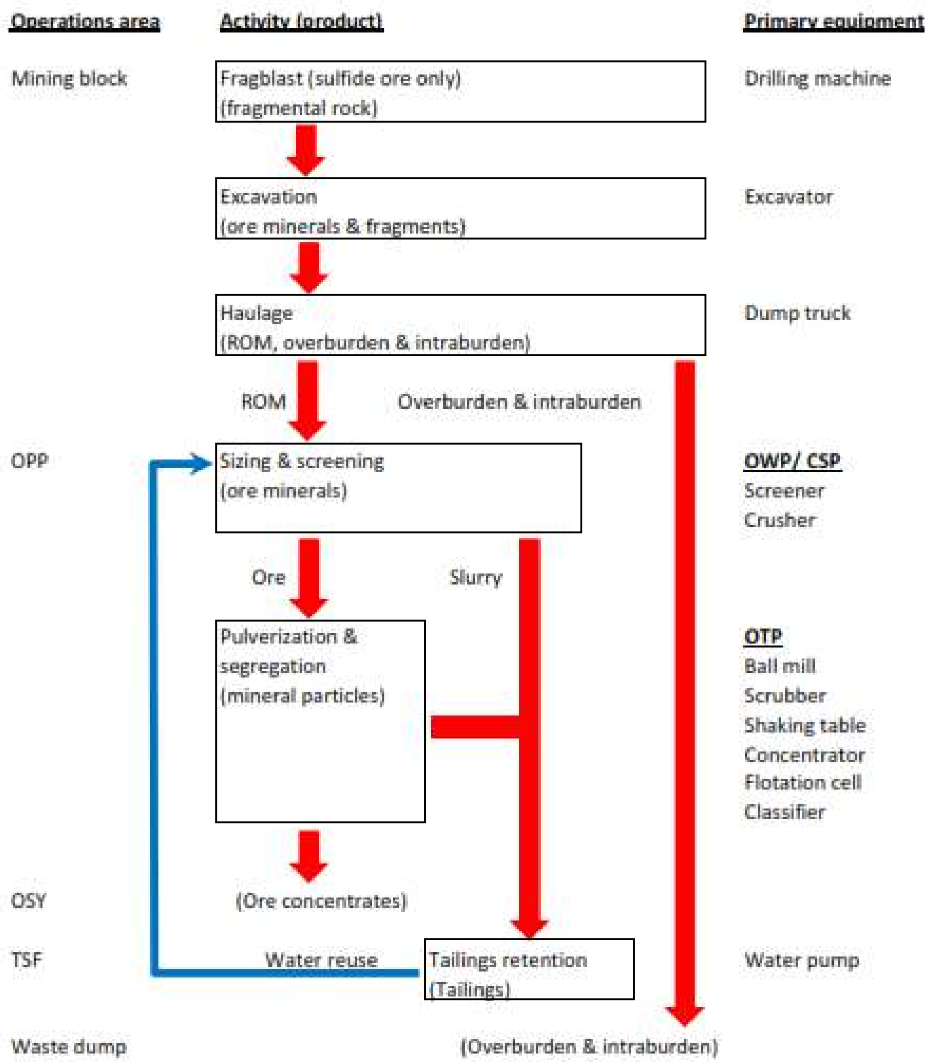
2.6.3 Mining Operations

The mining operations will consist of surface excavations and processing of both the oxidized and un-oxidized sulfidic ores, where the former is essentially unconsolidated to semi-consolidated in its physical nature thus confined to the surface layer, and is underlain by the latter in solid rock formation. The operations will begin at the ES-1 with mining of the oxidized ore possibly commencing during the OWP installation.

Mining of the oxidized ore

The oxidized ore is literally confined to the surface layer and will be mined by surface excavations using hydraulic excavators and the excavated materials (ROM) then trucked for processing at the on-site OWP to first separating the fine materials from the oversize (+20 mm) by water jetting, whereby the heavier finer materials will be subsequently pulverized (to 150 μm) for recovery of the free ore particles through a centrifugal concentrator, and the tailings retained in the wet ponds (TSF). The oversize are recycled for further breakdown through crushing into smaller fragments then pulverized to recovering the free gold. The OWP consists essentially of a large hopper lined with steel plates that is eventually linked on one part to the tertiary cone crushers (CSP) for the oversize and on the other the centrifugal concentrator through the scrubber in the OTP.

P 2.4: Process flow of the mining operations.



Mining of the sulfide (un-oxidized) ore

The sulfide (un-oxidized) ore becomes extractable only upon removal of the surface layer bearing the oxidized ore. Mining the sulfide ore will essentially require fragbalst, where the shot fragments will then undergo a series of processes from further sizing of the mineralized rocks through crushing to pulverizing (to 150 µm) then concentrating the ores through flotation using SEX (**Annex B5**) or equivalent as the collecting agent and the pulp alkalinity controlled using calcium carbonate ($CaCO_3$) and sulfuric acid (H_2SO_4) as the conditioners. The heavier particles are then segregated through gravitational separation in the classifier, with the lighter gangue minerals discharged as tailings and retained in the TSF.

The mining of the sulfide ore differs from the oxidized ore in that the former inevitably requiring rock blasting at the mining blocks along with a more complicated series of closed-circuit processes in the OTP to extracting the ore particles.

The used xanthates and the conditioners essentially will be classified scheduled wastes under SWR (2005) and categorized (**Table 2.4**) according to specific disposable nature of such materials.

Table 2.4: Scheduled waste categorization

Code	Description
SW1	Metal & metal-bearing wastes
SW2	Waste containing principally inorganic constituents which may contain metals & organic materials
SW3	Waste containing principally organic constituents which may contain metals & inorganic materials
SW4	Waste which may contain either inorganic or organic constituents
SW5	Other wastes

Overburden & intraburden clearance

Removing the overburden and intraburden materials will be progressive and continuous during the mine development and operations. The overburden and intraburden are essentially undesirable materials consisting mainly of waste earth and fragmental rocks with gangue minerals, and will be trucked for tipping at the waste dumps.

Waste Tipping

The slurry mixture (tailings) discharge from the OTP will be drained into the adjacent TSF consisting of a series of compartments necessarily lined with impermeable geo-membranes to not only preventing seepage of AMD into the ground but also possibly reusing of the treated water.

AMD generally refers to acid drainage resulted from sulfide oxidation through mining. AMD may have significant impacts affecting the economics of the mining operations owing to its corrosive effects on infrastructure and equipment, the limitations on water reuse and discharge, and mine closure options, in as much the potential long-term environmental impacts from decreasing pH and possibly increasing concentrations of heavy metals in the nearby water and soils.

On the other hand, the solid overburden and intraburden earth waste materials from excavations will be tipped on-site at the waste dumps tentatively proposed at 5 designated areas.

Stockpiling
The fragmental mineralized rocks may be temporarily stockpiled *in situ* at the mining blocks prior to processing or at the processing area as crushed aggregates ready for pulverization, or as processed auriferous ore concentrates in the sheltered storage yard for scheduled shipment.

Haulage & transportation
Dump trucks will be used for carrying the raw deposits from the mining blocks to the processing plant, specific to mining and are only used off-road. Trucking also will be engaged for transporting the processed ores from the on-site storage yard to the designated port for shipment, using the existing roads.

Routine Maintenance
The routines will include infrastructural maintenance covering the haul roads and waste dumps, and necessary servicing and repairs of the mine machinery and equipment *in situ* or at the on-site workshop.

2.6.4 Cessation

Cessation of the mining operations will require the Project to *inter alia* rehabilitating the disturbed areas such as the waste dumps, removing the structural hazards as appropriate, and necessarily maintaining the TSF secured and functional over an extended period of time.

3 DESCRIPTION OF THE EXISTING ENVIRONMENT

3.1 Physical Environment

3.1.1 Meteorology

Rainfall is convectional with monsoonal influence for an annual average about 1,826 mm over 172 wet days typical with increasing rain towards the year end.

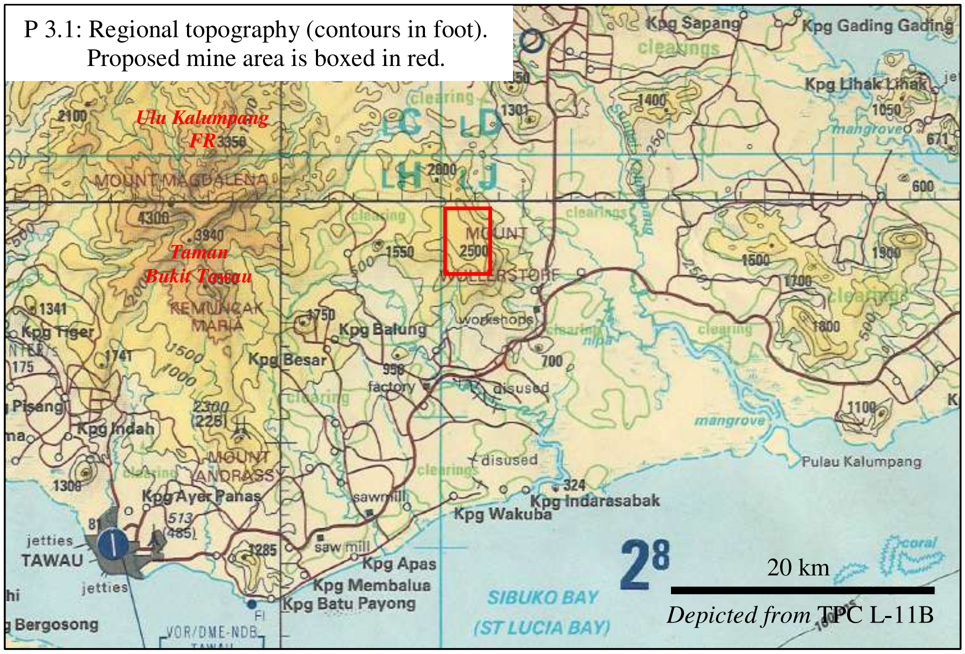
3.1.2 Topography

The site (refer **Figure A2**) may be generally divided into southwesterly and northeasterly dipping slope areas, separated by a curvilinear ridge grossly running through Bukit Mantri and Bukit Tundung. The Mantri peak is located just northwest off-site at an elevation about +564 m AMSL while the Tundung peak within the site at about +600 m AMSL edging the eastern boundary towards southeast.

The mineralized areas were identified lying essentially on the southwesterly dipping slope area, with the 2 mining blocks separated over about 2 km apart. The southwesterly dipping slopes gradually descend into Sg Mantri Kanan along the southwestern border areas lowest at about +200 m AMSL.

The processing facilities were proposed located at the lower ground area between the 2 mining blocks and adjacent to the other surface mine structures north of Sg Mantri Kanan by the road access entrance towards the western boundary.

P 3.1: Regional topography (contours in foot). Proposed mine area is boxed in red.



On a regional scale, the site covers the peak area (Bukit Tundung) of Mt Wullersdorf located east of Taman Bukit Tawau which covers the larger and higher Mt Magdalena separated essentially by Sg Mantri.

3.1.3 Hydrology

The site is located at about the centre area of the Kalumpang Basin, which covers an area about 1,006 km^2 encompassing Sg Kalumpang and its tributaries consisting mainly of Sg Malati and Sg Mantri where the latter branches into Sg Mantri Kanan originating in Mt Wullersdorf FR and Sg Mantri Kiri in Taman Bukit Tawau along with Sg Malati further upstream of Sg Kalumpang.

Sg Mantri Kanan is truncating the southwesterly dipping slopes along the southwestern site boundary areas, where the stream is about 6-m wide and is the nearest to the mine facilities. Sg Mantri Kanan runs westerly off-site to eventually merging with Sg Mantri Kiri about 10 km downstream before turning into Sg Kalumpang about 12 km further downstream. Sg Mantri Kanan originates in Mt Wullersdorf FR, while Sg Mantri Kiri and Sg Kalumpang in Taman Bukit Tawau and Ulu Kalumpang FR respectively.

The other stream at the upper eastern area cuts through the northeasterly dipping slopes of the site and is a tributary of Sg Tundong that also eventually runs into Sg Kalumpang about 10 km east off-site.

Water Quality

Water samples (**Table 3.1**; refer **Figure A1**) from Sg Mantri Kanan at the entry (SGD-WLF-WS1) and exit (SGD-WLF-WS2) points along the site boundary have generally indicated the ambient water quality (**Annex B.6**) not inferior to WQI Class III (**Table 3.2**), with traces of heavy metals (**Table 3.3**) grossly conforming to NWQSM Class II except with higher aluminium (0.4%) and manganese (0.16%) from the site.

P 3.2a: Water sampling (SGD-WLF-WS1) at the Sg Mantri Kanan entry point of the site. 11.11.2014

Table 3.1: Water sample localities

Sample no	WS1	WS2	WS3	WS4
Lat (N)	04°28'46.8"	04°29'46.4"	04°30'02.1"	04°36'03.7"
Long (E)	118°06'55.8"	118°06'02.8"	118°04'00.7"	118°09'51.2"
River	Sg Mantri Kanan			Sg Kalumpang
Position	Entry point	Exit point	Off-site tributary 5 km downstream west of WS-2	32 km off-site downstream NE of WS-3
Immediate influence	Mt Wullersdorf Forest Reserve	Mineral exploration	Oil palm plantation activities	

P 3.2b: Water sampling (SGD-WLF-WS2) at the Sg Mantri Kanan exit point of the site.
11.11.2014

P 3.2c: Water sampling (SGD-WLF-WS3) along an off-site tributary of Sg Mantri Kanan.
04.12.2014

Table 3.2: Water quality index (WQI)

Parameter	WQI Class II	WS1	WS2	WS3	WS4
NH_3-N (mg/l)	0.1 – 0.3	0.29	0.25	0.26	(0.37)
BOD (mg/l)	1 – 3	(5)	(6)	(4)	(5)
COD (mg/l)	10 – 25	3	< 2	14	11
DO (mg/l)	5 – 7	-	-	-	-
pH	6 – 7	-	-	7.6	7.8
TSS (mg/l)	25 – 50	8	14	5	4

NB: Disqualified parameters in brackets

Table 3.3: Baseline water quality

No	Parameter	WS1	WS2	WS3	WS4
1. Physical (mg/l unless stated otherwise)					
1.1	Temperature (°C)	-	-	26.0	27.3
1.2	Turbidity (NTU)	18	16	15	20
1.3	Coliforms (MPN/100ml)				
1.3a	Total coliform	23	17	350	280
1.3b	Faecal coliform	13	11	33	20
1.4	pH	-	-	7.6	7.8
1.5	BOD	5	6	4	5
1.6	COD	3	ND (< 2)	14	11
1.7	TDS	46	47	83	109
1.8	O&G	ND (< 1)	ND (< 1)	ND (< 1)	ND (< 1)
1.9	DO	-	-	10.3	68.1
1.10	TSS	8	14	5	4
2. Chemical (%)					
2.1	Ag (silver)*	ND[2]	ND[2]	ND[2]	ND[2]
2.2	Al (aluminium)	1.3	0.4	0.17	0.82
2.3	As (Arsenic)*	0.012	0.012	ND[3]	ND[3]
2.4	Cd (cadmium)*	ND[2]	ND[2]	ND[2]	ND[2]
2.5	CN (cynide)	ND[3]	ND[3]	ND[3]	ND[3]
2.6	Cr (chromium)*	ND[1]	ND[1]	ND[1]	ND[1]
2.7	Cu (copper)*	ND[2]	ND[2]	ND[2]	0.04
2.8	Fe (iron)	1.21	0.68	0.54	0.65
2.9	Mg (magnesium)	1.3	1.6	1.6	3.3
2.10	Mn (manganese)	0.06	0.16	0.06	ND[2]
2.11	Na (sodium)	1.5	1.6	2.3	4.2
2.12	NH_3-N	0.29	0.25	0.26	0.37
2.13	Ni (nickel)*	ND[2]	ND[2]	ND[2]	ND[2]
2.14	Pb (lead)*	ND[3]	ND[3]	ND[3]	ND[3]
2.15	Sb (antimony)*	ND[4]	ND[4]	ND[4]	ND[4]
2.16	Se (selenium)*	ND[4]	ND[4]	ND[4]	ND[4]
2.17	SO_4	12	21	16	8.2
2.18	Zn (zinc)*	ND[4]	0.02	ND[4]	ND[4]

*Heavy metals; ND: Not Detectable; detection limits: 1 (0.001), 2 (0.01), 3 (0.05), 4 (0.1)

The stream water has maintained about similar water quality further downstream (SGD-WLF-WS3 & SGD-WLF-WS4), despite the presence of oil palm estates in the neighbouring areas invariably immediate to the streams.

P 3.2d: Water sampling (SGD-WLF-WS4) along Sg Kalumpang.
04.12.2014

3.1.4 Geology

The proposed mining blocks are immediately underlain by the Pliocene andesitic flows and pyroclastics, intercalated with sedimentary clastics and intruded by granodiorite – dioritic dykes with auriferous (gold-bearing) veins, and further underlain by the older Kalumpang Formation.

Mineralization

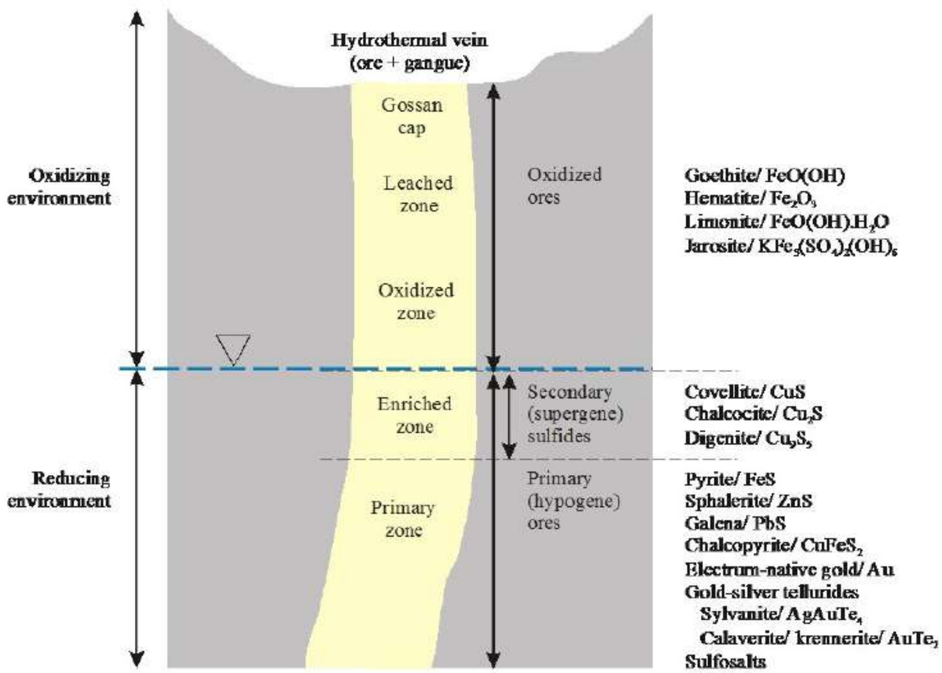
The ore mineralization essentially belongs to the epithermal system which occurred as a series of quartz-sulfide hydrothermal veins coalesce in tension fractures in the rock formation, where the ore mineralogy generally is characterized by pyrite, sphalerite, galena, chalcopyrite, electrum-native gold, sulfosalts and gold-silver tellurides. However, the sulfide ore is susceptible to oxidation through weathering upon prolonged exposure and may be thus subject to alteration and subsequently replaced by goethite, haematite, jarosite, limonite, covellite, chacocite, digenite and manganese oxides. Essentially, the oxidized ore is confined to the outer layer with a thickness about 20 m, while the sulfide ore believed reaching a depth up to 280 m

3.2 Biological Environment

3.2.1 Flora

The site presently remains largely covered with common forest vegetation, and is surrounded by Mt Wullersdorf and Ulu Kalumpang FR immediately south and north respectively. Oil palm is otherwise predominant, with plantation estates notably covering the neighbouring northern area from northeast to northwest.

P 3.3: Generalized mineralization at the site.



The Ulu Kalumpang – Mt Wullersdorf forest trees are mainly dipterocarps and non-dipterocarps, with the former consisting typically of *Cotylelobium* (eg Resak Tempurung), *Dipterocarpus* (eg Keruing), *Dryobalanops* (eg Kapur), *Parashorea* (eg Urat Mata) and *Shorea* (eg Selangan Batu, Seraya, Kawang and Melapi) and the latter *Anthocephalus* (eg Laran) and *Octomeles spp.* The Ulu Kalumpang and Mt Wullersdorf FR were estimated (SFD, 2011) about 16.3% and 9.4% of the forest areas already encroached by oil palm plantations (**Table 3.4**).

Table 3.4: Forest stratification & oil palm encroachment (*after* SFD, 2011)

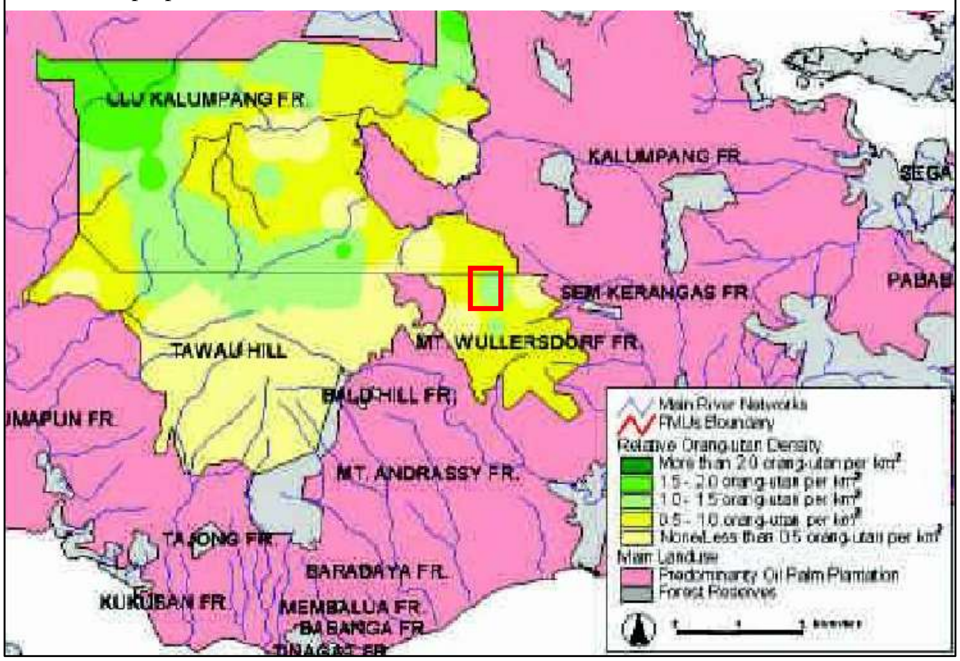
Forest reserve	Ulu Kalumpang FR		Mt Wullersdorf FR	
	Area (ha)	%	Area (ha)	%
Encroachment	8,528	16.34	734	9.37
Stratification				
Stratum 1	6,412	12.29	4,222	53.89
Stratum 2	8,172	15.66	2,879	36.75
Stratum 3	28,266	54.16	-	-
Stratum 4	808	1.55	-	-
Total	52,186	100.00	7,835	100.00

3.2.2 Fauna

Sabah Wildlife Department (2011) has reported the presence of mainly orangutan at the site, while the others including the clouded leopard, Bornean sun bear, pig-tailed macaque and banteng (SFD, 2012) largely in the neighbouring Ulu Kalumpang – Mt Wullersdorf FR along with the more common wild boar, deer, porcupine, greater mousedeer, Malay civet, long-tailed macaque, Bornean yellow muntjac, banded linsang and monitor lizard (WWF-MY, 2012 – unpublished, with permission)

The orangutan population was estimated a density about 5 – 15 at the site (Alfred et al, 2010), with no such population estimate reported otherwise for the other species at the site or the surrounding areas.

P 3.4: Orangutan population density (*after* Alfred et al, 2010 *as in* SWD, 2011).
The proposed mine site is boxed in red.



3.3 Socio-Economic Environment

3.3.1 Existing Land Use & Water Use

The site (refer **Figure A1**) is immediately surrounded by Ulu Kalumpang – Mt Wullersdorf FR, with otherwise mainly neighbouring oil palm plantations further off-site that essentially are also commonly using the existing connecting feeder roads to reaching the main road. Taman Bukit Tawau (Tawau Hill Forest Reserve) is located about 8 km west off-site, separated by an oil palm estate entirely enclosed by the forest reserves.

There are no indigenous communities within 5 km from the site, and the nearest is Kg Bukit Kawa located about 14 km south at the main road junction, while Kg Pinang (04°24'43.4"N, 118°06'00.0"E) the only riparian community and Sipadan Mangrove Resort (04°21'24.0"N, 118°19'11.8"E) the only resort establishment along Sg Kalumpang, located amidst the mangrove forest area about 70 and 80 km downstream respectively from the site.

P 3.5: Kg Bukit Kawa by the main road roundabout.

04.12.2014

P 3.6: Sipadan Mangrove Resort near Sg Kalumpang estuary.

04.12.2014

There are no established potable water intake stations along Sg Mantri Kanan, nor further downstream thereafter or along Sg Kalumpang until the estuary about 83 km downstream from the site.

3.3.2 Gazette (Designated) Land Use

The site covers an area recently excised from Mt Wullersdorf and Ulu Kalumpang gazette protection (Class 1) forest reserves, which have remained covering the larger areas off-site (refer **Figure A1**) immediately south and northwest respectively, with the further surrounding areas designated otherwise Countryside Area.

4 SCOPE OF STUDY

The EIA will predict and evaluate the adverse environmental impacts from the mining operations and proposing mitigation measures against such impacts along with recommended monitoring programmes to maintain compatibility of the Project with protection of the environment.

4.1 Main Environmental Impacts

The following environmental impacts are prioritized for the Project.

- Water pollution (physicochemical, including sedimentation)
- Waste disposal (overburden/ intraburden, tailings and scheduled wastes)
- Soil erosion
- Ecological impact
- Safety and health hazards (including flyrocks)

4.2 Other Potential Impacts

Other adverse environmental impacts are as follows:

- Air pollution (on-site)
- Noises (on-site, including airblast)
- Ground vibration (fragblast)
- Traffic and transportation (including traffic noises off-site)
- Landscape modification

Any other impacts not listed herein but which may be deemed associated with the Project shall be identified and determined during the course of EIA.

4.3 EIA Matrix

Some of the development activities will be run concurrently with the mining operations, and the impacts (**Table 4.1**) essentially will be similar in nature and are hence assessed integral to the operations.

The potential and significance of the impacts were evaluated based upon integrated assessment in relation to the following 4 criteria specific to the environmental and proposed operational settings (without consideration of practicable mitigation).

Table 4.1a: EIA matrix (no-mitigation option)

Environmental Aspect	Impact	Assessment Rating				Score
		M	P	R	C	
Development & Operation						
Physical	Water pollution	3	3	2	3	Major
	Waste disposal					
	Tailings	2	3	3	3	Major
	Scheduled waste	1	2	2	3	Medium
	Earth dumps	1	3	2	2	Medium
	Soil erosion	1	3	3	3	Medium
	Air pollution	2	2	2	1	Minor
	Noises (on-site)	2	2	1	2	Minor
	Ground vibration	2	2	3	3	Medium
	Landscape modification	1	3	3	2	Medium
Biological	Ecological impact	2	2	3	3	Medium
Socio-economic	Safety & health hazards	2	3	3	3	Major
	Traffic & transportation	2	2	2	2	Minor
Abandonment						
Physical	Landscape / aesthetics	1	3	3	2	Medium
	Waste management					
	Tailings	2	3	3	3	Major
Biological	Ecological impact	1	1	1	1	Minor
Socio-economic	Safety & health hazards	1	3	3	3	Medium

Table 4.1b: EIA rating and impact score

Aspect	1	2	3
Assessment			
Magnitude (M)	Within site	Local	Regional
Permanence (P)	Negligible	Temporary	Permanent
Reversibility (R)	Negligible	Reversible	Irreversible
Cumulative (C)	Negligible	Non-cumulative	Cumulative
Adverse Impact Potential			
Score	Minor	Medium	Major

- The *magnitude* (M) of change/ effect relative to the spatial boundaries and is measured as follows:
  (1) change/ effect is confined within the project site
  (2) change/ effect is local and/ or limited to immediate surroundings
  (3) change/ effect is regional
- The *permanence* (P) of the impact, indicating temporary or permanent of the condition, and is measured as follows:
  (1) effect is negligible/ no change/ not applicable
  (2) temporary effect
  (3) permanent effect

- The *reversibility* (R) of the impact, indicating if the condition can be changed and is controllable over its effect, and is measured as follows:
  (1) effect is negligible/ no change/ not applicable
  (2) effect is reversible
  (3) effect is irreversible
- The *cumulative* (C) extent of the impact, indicating if the impact will have a single direct effect or cumulative effect over time, or a synergistic effect with other conditions, and is measured as follows:
  (1) effect is negligible/ no change/ not applicable
  (2) effect is non-cumulative/ single
  (3) effect is cumulative

4.4 Zone of Impact (ZOI)

The impact influence (ZOI) can be far-reaching and the effect possibly long-term dependent upon the characteristics of the impacts. Hence, the influence coverage (**Table 4.2**) has been identified specific to these impacts (**Table 4.1a**) relative to the environmental sensitivity of the surrounding influence areas.

Table 4.2: ZOI

No	Impact	Primary effects	Potential ZOI
1	Water pollution	Physicochemical water contamination	Sg Mantri – Kalumpang
2	Waste disposal		
3	Soil erosion	Slope failure	Benching slopes (on site)
4	Ecological	Floral & faunal habitat destruction	Ulu Kalumpang – Mt Wullersdorf FR
5	Safety & health	Safety & health	Work place (on site)
6	Air pollution	Dusting	Local surroundings
7	Noises	Noises	Local surroundings
8	Fragblast	Airblast & ground vibration	Local surroundings
9	Traffic & transportation	Socio-economic (traffic pollution & safety)	Haul road & local surroundings
10	Landscape modification	Aesthetic depreciation	Local surroundings

Some of the impact influence may be controlled primarily by the local topography, which typically include but not limit to water pollution, while some others invariably effected by physiographical factors.

5 DESCRIPTION OF THE IMPACTS & PROPOSED ASSESSMENT METHODOLOGY

While there can be no zero impact possibly achievable, there is existing practicable mitigation that which may be compatible with the local settings and applicable to the Project

5.1 Main Environmental Impacts

5.1.1 Soil Erosion

Soil erosion is the function of erosivity of rainfall and erodibility of soil, whereby the rains essentially scour away, loosen and break soil particles then washed down by the force of gravity and get carried away to hence resulting in soil loss, leaving behind an altered bare surface. Consequently, an altered bare slope surface with the formation of sheet, rill and gully erosion features will easily become destabilized and eventually lead to slope failure or landslide. Soil loss (A) often may be estimated using RUSLE (**Equation 1**).

$$A \text{ (mt/ ha)} = R*K*LS*C*P \quad \text{- Equation 1}$$

where
- R = Rainfall erosivity factor
- K = Soil erodibility factor
- LS = Slope length & steepness factor
- C = Cover management factor
- P = Erosion control practice factor

Soil erosion is natural, but the process often may be invariably accelerated under anthropogenic influence such that the mining operations will inevitably expose the bare surfaces to erosion, typically the unconsolidated/ semi-consolidated earth surface at the mining blocks and waste dumps.

Aim of Mitigation

- To minimize soil loss that may otherwise lead to physical water pollution by way of sedimentation
- To maintain stable earth wall/ benches at the waste dumps and TSF

Assessment Methodology

- Soil loss estimation using RUSLE as a basic instrument to identifying the best erosion control practice
- Engineering and geological assessments to designing stable and sustainable slopes for the mining blocks, waste dumps and TSF
- Identification of monitoring stations and frequency requirements based upon the above assessments

Monitoring Programmes

- Compliance monitoring on the engineered slopes and such related stability enhancement installations
- Reporting on slope/ design failure and the restorative rectification

5.1.2 Water Pollution

Physical

Eroded soil materials typically get carried by the surface runoff and deposited downstream (ie sedimentation) whereby the sediment yield (Y) may be estimated using MUSLE (**Equation 2**) and is specific to a storm event. Sediment yield is defined as the amount of eroded soil delivered to a point in the watershed that is remote from the original of the detached soil particles, which includes the erosion from slopes, channels and mass wasting but excluding the deposition amount before reaching the point. Serious downstream sedimentation often causes the rivers and waterways to shallow and prompting flash and regular floods in the low-lying areas.

$$Y\ (\text{mt}) = 89.6(V*Q_p)^{0.56}(K*LS*C*P) \qquad \text{- Equation 2}$$

where
- V = Runoff volume
- Q_p = Peak discharge
- K = Soil erodibility
- LS = Slope length & steepness
- C = Cover management
- P = Erosion control practice

Geochemical

Oxidation of the sulfide ore minerals by way of weathering is a natural process that eventually leads to minerals replacement through chemical reactions and the beginning of acid (H^+) forming process such as follows:

FeS_2 (pyrite) + $3\frac{1}{2}O_2 + H_2O \rightarrow Fe^{2+} + 2SO_4^{2-} + 2H^+$ - Reaction 1A
$Fe^{2+} + \frac{1}{4}O_2 + H^+ \rightarrow Fe^{3+} + \frac{1}{2}H_2O$ - Reaction 1B
$Fe^{3+} + 3H_2O \rightarrow Fe(OH)_3 + 3H^+$ - Reaction 1C

Oxidation (**Reaction 1B**) of Fe^{2+} (ferrous iron) to Fe^{3+} (ferric iron) in the mine water may take several travelling kilometres downstream under natural influence to result in precipitation (**Reaction 1C**) of $Fe(OH)_3$ (ferric hydroxide) through hydrolysis of Fe^{3+}, which otherwise may accelerate further sulfide oxidation (**Reaction 2**) in the presence of sulfide such as follows:

FeS_2 (pyrite) + $14Fe^{3+} + 8H_2O \rightarrow 15Fe^{2+} + 2SO_4^{2-} + 16H^+$ - Reaction 2

The precipitation of $Fe(OH)_3$ is a key acid producing stage, and would be inevitable with oxidation of Fe^{2+} to Fe^{3+} and the subsequent hydroxide formation upon oxidation (**Reaction 1A**) of the sulfides to sulphates.

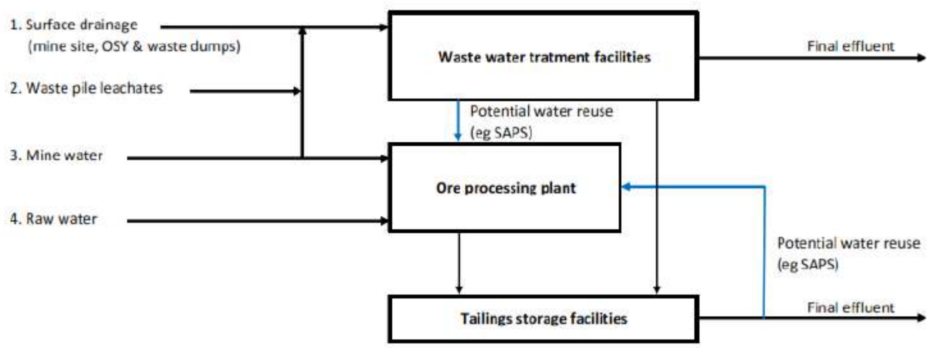
Aim of Mitigation

- To regulate surface runoff prior to entering natural waterways
- To maintain outflow water quality conforming to required standard
- To contain sedimentation and chemical pollution
- To retard AMD formation for possible water reuse in mineral processing

Assessment Methodology

- Erosion and sedimentation assessment with reference to MSMA guideline
- Engineering assessment to designing the mine layout, drainage and TSF
- Analysis on the baseline water quality (refer **Section 3.1.3**) to establishing conformance requirement with reference to NWQSM and MOH standards
- Geochemical assessment to identifying potential mineral-related hazards
- Analysis on the viable AMD containment (including contingency) and treatment (active/ passive including SAPS) options, for possible reuse of water in mineral processing
- Identification of monitoring stations and frequency requirements based upon the above assessments

P 4.1: Conceptual water balance & potential water reuse.



Monitoring Programmes

- Conformance monitoring of the water quality of effluent from TSF with reference to established limits
- Compliance monitoring on the proposed water pollution mitigation and such related installations
- Reporting on spills and leaks of influent, effluent or such other hazardous materials and the restorative rectification

5.1.3 Waste Impacts

The disposable waste materials may be categorized as liquid (aqueous) or solid, and hazardous or non-hazardous in nature. The hazardous materials essentially are more damaging to the environment and hence classified scheduled wastes regulated under SWR (2005), with the non-hazardous materials remaining notwithstanding possible environmental risks.

Overburden & Intraburden

The overburden will consist generally of ordinary earth materials stripped from the mining blocks, while the intraburden the non-mineralized rocks and will tipped in multiple tiers at the designated waste dumps.

Tailings

The tailings will consist of undesirable gangue minerals derived essentially from processed ores, mixed with water and are invariably exposed to oxidation and hence formation of AMD. The tailings will be contained and treated in TSF (wet ponds) for possible recycle and reuse of the treated water at OWP.

Scheduled Wastes

The scheduled wastes (refer **Table 2.4**) from the mining operations will typically include spent motor oils and chemicals, disposable or possibly recyclable for off-site reuse. Essentially, the containment and handling of these spent materials will be primary to preventing spills and leaks to the natural environment.

Aim of Mitigation

- To minimize environmental hazards through regulating containment of the environmental waste materials
- To contain the waste materials within physical limits

Assessment Methodology

- Assessment on site suitability for the proposed waste dumps and TSF with reference to local environmental setting, topographic reliefs and foundation stability

Monitoring Programmes

- Compliance monitoring on the structural integrity of the containment facilities

5.1.4 Ecological Impacts

The chain mining activities from development to cessation of the operations will inevitably introduce impact to the influence area. Typically, the impact will be considerably long-term and the effect irreversible depending upon the scale of the operations. Drastic ecological impacts will invariably lead to broken food chain in the ecosystem, which eventually further endanger the wildlife species.

The changing ecology often is accelerated with destruction of the natural habitats, and the adaptation thereafter further disturbed and possibly decelerated by the various impacts associated typically with noises, air pollution and human activities.

Aim of Mitigation

- To minimize disturbance on the existing ecosystem
- To sustain floral and faunal conservation

Assessment Methodology

- Analysis on existing research data
- Interactive collaboration and discussion with the relevant authorities and organizations, which include but not limit to SFD, SWD and WWF
- Analysis on viable faunal conservation options such as translocation and establishing wildlife corridor
- Pre-development population (orangutan) surveillance for the proposed disturbed and influence area
- Identification of monitoring stations and frequency requirements based upon the above assessments

Monitoring Programmes

- Compliance monitoring on the forest reserve (100 m) and riparian (50 m) buffers
- Compliance monitoring on land clearance with reference to RIL specifications
- Compliance monitoring and policing on prohibition against hunting and disposal of waste materials with harmful chemical composition

5.1.5 Safety & Health Hazards

Safety and health hazards are closely associated with workers and the public at large. Consequently, a sound management with stringent environmental policy will be critical to essentially providing a conducive and safe working environment.

Aim of Mitigation

- To minimize safety and health risks
- To promote environmental performance

Assessment Methodology

- Risk analysis on workplace safety and health
- Applicability analysis on PPE with reference to JKKP standard
- Practicability analysis on SOP for the mining activities and handling of equipment

Monitoring Programmes

- Compliance monitoring as per regulatory requirements

5.2 Other Potential Impacts

5.2.1 Air Pollution

Air pollution includes dusting, exhaust smokes and fumes, which are also inherent to the mining operations. Dusting will inevitably come from the various mining activities ranging from drilling to crushing and screening to trucking while toxic fumes (CO, NO_X and SO_X) from blasting and smokes from the running machinery.

Aim of Mitigation

- To control and suppress excessive dusting, unwarranted toxic fumes and exhaust emissions

Assessment Methodology

- Assessment on the mining equipment options, prioritizing machinery with dusting suppression and low exhaust emissions
- Assessment on the ambient air quality (TSP) using TAS
- Assessment on periodic/ continuous monitoring requirement for the mining operations
- Identification of monitoring stations and frequency requirements based upon the above assessments

Monitoring Programmes

- Conformance monitoring of dusting (TSP) with reference to MAAQG
- Compliance monitoring on the proposed air pollution control/ suppression mitigation and such related installations

5.2.2 Noises

Noises are inherent to running machinery and various activities, and the impact is naturally inevitable. The proposed mining operations will hence introduce noises additional to the ambient environment, invariably through the working machines and the various mining and processing activities throughout the mine development and operations. These inherent noises are audible and non-destructive, but often can be disturbing or hazardous to occupational safety and health.

On the other hand, airblast can be structurally destructive owing to its very low frequency typically beyond our audible spectrum, more particularly when the resonance of the vibration is amplified by the structures with similar natural frequency and that if such resultant amplitude and PPV of the vibration are sufficiently high. Airblast typically is derived from blasting (detonation) and is short-lived.

Aim of Mitigation

- To maintain noise levels within permissible boundary, and within environmental and safe working limits

Assessment Methodology

- Forestry and cadastral buffer assessment
- Assessment on the mining and processing activities to establishing the conformance requirement on permissible operating hours with reference to prevailing JAS and JKKP standards, and to identifying monitoring stations
- Formulation of blast design based upon local environmental setting with reference to prevailing JMG guideline
- Identification of monitoring stations and frequency requirements based upon the above assessments

Monitoring Programmes

- Conformance monitoring of the noise levels with reference to established limits
- Compliance monitoring on the proposed noise mitigation and such related installations

5.2.3 Ground Vibration

Ground vibration may be natural from seismic activities such as earthquakes, or resulted from blasting activities. Tectonically, Sabah by large is free from the destructive forces of earthquakes in as far the regional geological setting shall remain unchanged, but may be subject to repeated intermittent episodes of tremors that are inevitable natural occurrences associated with the distant (> 2000 km) earthquake epicentres.

On the other hand, rock blasting (fragblast) activities also trigger ground vibration as a result of shockwave released from detonation of explosives. Depending upon the blast design and rock characteristics, the immense amount of explosive energy may be transformed into ground vibration and/ or flyrocks which nonetheless are both destructive and may cause serious structural damages.

Improper blast designs not only produce excessive ground vibration but also airblast and flyrocks, while good designs trigger minimum ground vibration, less airblast and flyrocks, and more importantly optimizing fragmentation.

Aim of Mitigation

- To optimize fragblast with appropriate blast design

Assessment Methodology

- Engineering and geological assessment to designing the blast based upon characteristics of the rock formation with reference to the local environmental setting, cadastral and structural buffering requirements
- Assessment on explosives and blast initiation options with SHE prioritization
- Assessment on scheduling of fragblast and explosives storage options
- Identification of monitoring stations and frequency requirements based upon the above assessments

Monitoring Programmes

- Conformance monitoring of blast vibrations with reference to established JAS and JMG limits
- Compliance monitoring of fragblast with reference to established buffering requirements
- Reporting on environmental hazards triggered by blasting

5.2.4 Traffic & Transportation

Transportation by trucking of the processed ores *en route* from the site to the nearest port will essentially make use of the existing access roads, with a section currently unsealed and that trucking may hence inevitably aggravate dusting, more significantly during long dry period.

The trucking transportation will also incur an increase in the haulage traffic density along the existing common feeder roads, which currently appear chiefly used by the plantations as the main haul route to the main road.

Aim of Mitigation

- To minimize traffic impact affecting Kg Bukit Kawa
- To possibly avoid road accidents

Assessment Methodology

- Traffic observations and prediction on foreseeable changes

Monitoring Programmes

- Compliance monitoring on the proposed dusting and traffic safety mitigation and such related installations

5.2.5 Landscape Modification

Surface mining will eventually allow massive topographic alteration with large depressions through massive excavations at the mining blocks and raised elevations at the waste dumps. The landscape changes are normally permanent, with the progress dependent essentially upon the scale of operations.

While topographic restoration currently remains uncommonly practiced or reasonably practicable for mining, rehabilitation is a preferred and more viable option to minimizing the risk of environmental hazards after the mine life, primarily associated with AMD.

Aim of Mitigation

- To appreciate environmental aesthetics of the mined-over/ disturbed areas
- To contain environmental hazards from the mined-over/ disturbed areas

Assessment Methodology

- Assessment on the prevailing rehabilitation options with reference to the local settings
- Analysis on AMD prevention alternatives for the mined-over and/ or disturbed areas

Monitoring Programmes

- Compliance monitoring on the proposed rehabilitation

6 DATA COLLECTION

The TOR was based upon the following findings and sources of reference.

6.1 Activities

- Site reconnaissance on 21.08.2014 and assessments on 11.11.2014 and 04.12.2014 to correlating the environmental settings with the proposed concept of mining operations
- Baseline water sampling at the entry and exit points of Sg Mantri Kanan along the proposed border area of the site, and downstream at the immediate river junction offsite and Sg Mantri – Kalumpang junction (refer **Section 3.1.3**)
- Land use and water use assessment along Sg Kalumpang up to estuary and along the access road from the main road junction (refer **Section 3.3.1**)
- Liaison with SFD, SWD and WWF-MY on floristic and faunal researches and findings (refer **Section 3.2**)

6.2 Data

6.2.1 Maps & Plans

Cadastral

- *District of Tawau map.* Scale 1:12,500. JTU, KK

Geological

- *Geological map of Sabah.* Scale 1:500,000. 1985; *Hydrogeological map of Sabah & Labuan Island.* Scale 1:500,000. 2007. JMG, KK

Soil

- *The soil of Sabah – Tawau NB 50-15.* Scale 1:250,000. 1974. UK

Topography

- *Restricted map Apas Balung 4/118/9 & Mastyn 4/118/5.* Scale 1:50,000. 1985. JUPEM, KK
- *Tactical pilotage chart TPC L-11B.* Scale 1:500,000. 1989. DGMS, London

6.2.2 Documents & Reports

Legislation

- *Environment Protection Enactment.* 2002. State Gov of Sabah, KK
- *Environment Protection Enactment (Prescribed Activities) (EIA) Order.* 2005. State Gov of Sabah, KK
- *Mineral Development (Operational Mining Scheme, Plans & Record Books) Regulations. PU(A)067/2007.* 2007. JMG, KL
- *Mineral Enactment.* 1999. State Gov of Sabah, KK
- *Wildlife Conservation Enactment.* 1997. State Gov of Sabah. KK

Reporting guidelines

- *Handbook on EIA in Sabah.* 2005. JPAS, KK
- *EIA guidelines for mines & quarries. EG 7/95.* 1995. JAS, KL

Other references

- *A summary of passive & active treatment technologies for AMD.* 2005. ACMER
- *Forest conservation management plan – Ulu Kalumpang Forest Reserve, Mt Wullersdorf Forest Reserve, Kalumpang FR & Madai Baturong FR (01.01.2011 – 31.12.2020).* 2011. SFD
- *Introduction mining engineering.* 2002. JWS
- *Malaysia's 5th national report to convention on biological biodiversity (CBD).* 2014. MNRE
- *Orangutan Action Plan (2012 – 2016).* 2011. SWD
- *Proposed opencast mining scheme in Mining Lease of 1,000 ha for gold mining operation in Mount Wullersdorf area, Tawau..* 2014. KMCS, PJ
- *Rainfall data for Tawau.* 2011. JMM, KK
- *Report on clouded leopard survey in Ulu Kalumpang FR, Sabah.* 2012. WWF-MY
- *The Ulu Kalumpang – Wullersdorf sustainable forest management project. In Forestry Annual Report.* 2012. SFD

6.3 Consulting Authorities

- Jabatan Alam Sekitar
- Jabatan Hidupan Liar Sabah
- Jabatan Meteorologi Malaysia
- Jabatan Mineral & Geosains
- Jabatan Pengairan & Saliran
- Jabatan Perancang Bandar & Wilayah
- Jabatan Perhutanan Sabah
- Jabatan Perikanan
- Jabatan Perlindungan Alam Sekitar
- Jabatan Tanah & Ukur
- Majlis/ Pejabat Daerah Tawau

7 WORK SCHEDULE

The Special EIA is anticipated (**Table 7.1**) completion within about 10 weeks from TOR approval, subject to available information and data and such other additional inputs as may be determined by JPAS.

Table 7.1: EIA scheduling and reporting

Activity \ Week	1	2	3	4	5	6	7	8	9	10
Field surveys, sampling & data collection										
Data collation, analyses & interpretation										
Drafting report										
Draft report review										
Finalizing report & submission to JPAS										

8 STUDY TEAM

Table 8.1 lists the EIA team members for the Project.

Table 8.1a: Study team members

No	Name	Reg no/ Exp date	Responsibilities	Fields of expertise
1	**Tan Han Meng** CPESC, MIGM, FIQ	S0018/ 30.09.2015	Project manager, geological, mining engineering, safety & health	Geology & blasting
2	**Hillery Niting**	S0019/ 30.09.2015	Socio-economic & land use	Socio-economics & land use
3	**Freddy Lee**	S0023/ 30.09.2015	GIS	Survey & mapping/ GIS
4	**Ng Ling Pheng** CHRA	S0179/ 12.02.2016	Air, noise & water quality	Air, noise & water quality

Table 8.1b: Supporting team members*

No	Name	Responsibilities
1	**Albrecht P Raphael** B Eng Chemical Engineering	Chemical health risk & waste management
2	**Ivoni Felix** B Sc (Hons) Conservation Biology	Biological & ecological
3	**Mohd Afinday Ahmad** B Sc (Hons) Conservation Biology	Air, noise & water quality

*Registration with JPAS pending